NATURAL HISTORY

THE JOURNAL OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XXII

1922

Published bimonthly by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK CITY

1922

An illustrated magazine devoted to the advancement of Natural History, the recording of scientific research, exploration, and discovery, and the development of museum exhibition and museum influence in education. Contributors are men eminent in these fields, including the scientific staff, explorers, and members of the American Museum

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

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NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

JANUARY–FEBRUARY, 1922

[Published April, 1922]

VOLUME XXII, NUMBER 1

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to Henry P. Davison, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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A PHENOMENON OF THE SEA BOTTOM

A polynoid worm has been seized by a crab and snipped in two. Retained in the claw of the crab is the posterior portion, which is the less useful to the worm. It is wriggling and luminescing, thus engaging the crab's attention and enabling the anterior portion to crawl away quietly and inconspicuously. Two luminescent scales have become detached from the posterior end of the worm and appear as bright oval patches in the picture. Drawing by R. Bruce Horsfall, from descriptions by Ulric Dahlgren; originally published in the *Journal of the Franklin Institute*

NATURAL HISTORY

VOLUME XXII JANUARY–FEBRUARY, 1922 NUMBER 1

PHOSPHORESCENT ANIMALS AND PLANTS

BY

ULRIC DAHLGREN*

HOW many of us have observed the sparkling of the fireflies over field or meadow or among the trees on a summer evening, or the glowing and scintillation of the sea in the wake of a vessel or rowboat at night as the boat cut through the water? Perhaps all who read this have done so, while a fewer number have observed the "fox fire" in rotten wood in the forest, have seen the glowworm steadily shining in the grass, or have even been made aware of the light that sometimes comes from dead fish on the beach or wharf even when these fish have been "salted down" preparatory to drying.

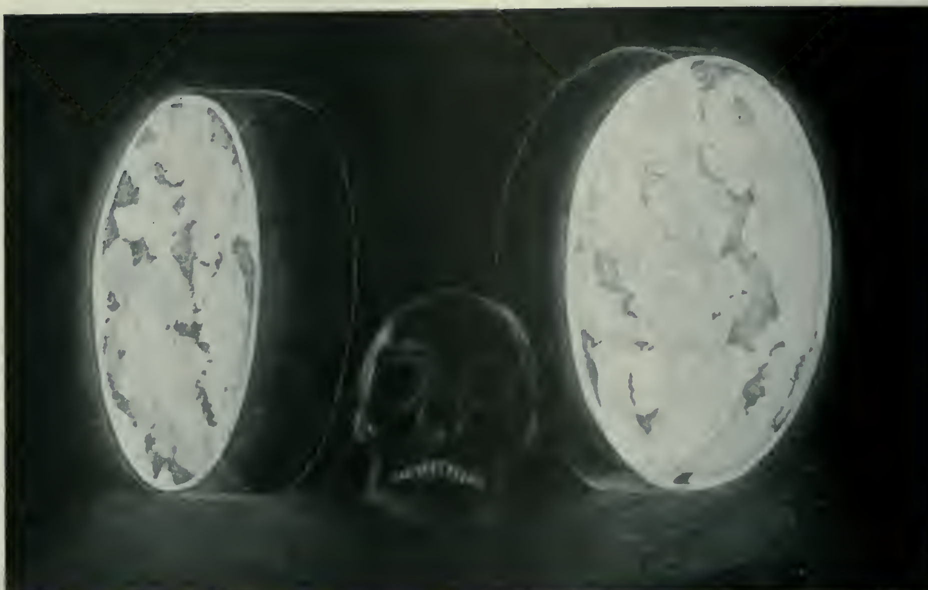
Practically all of us, however, are still unaware of the vast number and variety of animals and plants that can emit light. Only a very few travelers, scientists, and occasional observers have seen the light that comes from very many species of bacteria, fungi, jellyfishes, starfishes, worms, mollusks, crustaceans, tunicates, and fishes.

There is good reason for this pardonable ignorance. Hundreds of intelligent observers, even professional zoölogists, have captured and studied these various interesting forms in the daytime and their light has passed unobserved or has been masked by the brighter light of the sun. It is not natural or easy for people to leave their cosy homes, tents, or cabins in the night to go out and capture the smaller kinds of sea life, and even when they do so, the presence of firelight, torch, or lantern is almost as apt as is daylight itself to conceal the light of the luminous forms. It takes a special, well-directed effort to make such captures, an effort that is sometimes hard and disagreeable, as well as expensive, and one that is made only by the professional scientist or very eager amateur in search of this especial phenomenon. Again, a very large number of the most interesting of these organisms live deep in the waters of the ocean, on bottoms or under stones at depths of from fifty to thousands of feet. In order to see some of these forms in action one must have large, expensively equipped vessels with dredges and skilled crews, and must dredge night after night for long periods.

The writer proposes to present in this article illustrations of some of the most interesting and typical of these creatures depicted by artists from life or from descriptions, to point out some of the simpler features of the structures by means of which they use the light produced, and to explain some of the important facts of the fundamental chemistry by which the light is generated.

First, it must be explained that all of this light is produced by the oxidation or burning of a substance named "luciferin," that has been secreted in the living flesh or protoplasm of the organism's body cells. This substance, once so secreted, is no longer living material but is a product which may be used at once or may be stored, either in the living cell or in internal reservoirs, until it is needed to produce the light either in the living cells, in cavities of the body, or outside the animal in the surrounding water or

*Professor of Biology, Princeton University, and Director of the Harpswell Laboratory.



Even certain bacteria are luminous. The picture, which is derived from Molisch, shows two agar plates on which colonies consisting of millions of these microscopic light-producing organisms are gathered. So strong was their combined luminescence that it made possible the photographing of the skull shown between them

A common form of marine dinoflagellate found on the Atlantic coast is *Ceratium tripos*. From a photograph that appeared in the *Journal of the Franklin Institute* air. Secondly, while the luciferin alone will oxidize without showing any light, it requires the presence of a second substance, also secreted by the animal's body and called "luciferase," in order that its chemical combination with oxygen shall produce the light. Strange to say, only very little, almost no heat is generated by this oxidation. In nearly every case the light amounts to more than 99 per cent of the energy released while only a fraction of 1 per cent of heat appears.

Even among the lowest, but not physiologically the simplest, of living organisms, the bacteria, we find some species that can produce light. Such bacteria live mostly, almost exclusively, in the sea and more than fifty species have been described by investigators. Practically *any* single gallon of water that one draws from the ocean contains one or more of them and they are present in larger numbers in the slime on the surfaces and in the various body cavities of almost all animals that live in salt water. But although these generally distributed individuals are in normal health and are multiplying and absorbing food, they do not produce light and shine under circumstances such as these. It is only when they are suddenly given a supply of rich food by being placed, for instance, on the dead body of a fish or other animal, and have multiplied into masses containing millions of individuals, that they begin to emit the beautiful greenish yellow or greenish blue light that is characteristic of them. The upper figure on p. 6 shows two agar plates on which colonies of these microscopic creatures have formed masses of a transparent, jelly-like slime. Sufficient light was present to photograph the old skull placed between them.

At this stage in their history every individual is secreting luciferin and burning it, *inside* of the body flesh as fast as it is secreted, to produce the wonderful light. When the food becomes too old through decay and when the other secretions of their bodies have poisoned the mass, the light ceases, and then the bacteria become scattered in the water, are killed by drying, or become attached to some living animals, passing out of cognizance until some of their descendants find by a happy accident another favorable supply of suitable food and the phenomenon repeats itself.

The light is continuous as long as the favorable conditions last and almost never are the bacteria the source of the sea light that we see in the wake of a vessel or on the crests of the waves in rough weather. Among the several organisms that do make this familiar ocean light are other forms of one-celled, microscopic creatures. These are the marine dinoflagellate protozoa, which are also claimed by botanists under the name of the Peridinidæ.

There are a great many species of these organisms. Those members of the group that live in fresh water do not emit light, but most of those that live in the sea have the power of shining. The marine species float on the surface and are found in all seas. *Noctiluca*, a small, rounded or heart-shaped creature, lives on the surface in such numbers in favorable seasons that the sea is colored a brownish red or rusty color. *Ceratium tripos*, another kind, triangular in shape with three long, curved projections like horns, is equally abundant, but is so clear and transparent that its presence is not indicated to the eye. Various other similarly shaped species are found. One variety, found in the lower ends of Chesapeake and Delaware bays, grows in long chains and, like *Noctiluca*, gives a reddish color to the water.

The light of these creatures is produced by the same substance, luciferin, secreted in the same way in their flesh as in the bacteria, but the method of its use after being secreted differs in one important particular. The luciferin is not secreted all through the body but only at more or less numerous points and is stored at these points in tiny granules, to be used at the proper time. That time is at night and then only when the organism is stimulated by physical or chemical means. The bacterium goes on shining continuously day and night, light or dark. The light-giving dinoflagellate gives a bright spark of light only when stimulated to do so through the stirring of the water by an oar, or by a wave break, or when some unpleasant chemical substance like alcohol or ammonia, is thrown into the water. *Ceratium* gives a short, sharp flash lasting only a fraction of a second. *Noctiluca* gives a slower glow differing in degree according to the strength of the stimulus. The lower figure, p. 6 shows one of these forms, *Ceratium*, photographed by its own light.

When fresh, this fungus, *Clitocybe illudens*, shows phosphorescence at night. The fungus is normally a rich saffron yellow, although sometimes old plants become a sordid brown. (From *Mushrooms* by Atkinson)

Turning now to the only true plants that give light of this kind, we find that a few species of fungi of the toadstool forms are able to shine. In some it is the mycelium, the plant's main underground body, a thin network of branching strands, that can do so, in others it is only the sporophore, or familiar toadstool structure, that has this potency, while in the case of a few fungi all parts can shine. Here we find that the light comes from all the cells of a part of the body and that, as in the bacteria, the light is a continuous glow, the luciferin being burned as fast as it is secreted, night or day, stimulus or no stimulus. Sometimes the plant glows for all of its lifetime, as in some mycelia; in other cases, as in *Clitocybe illudens*, the sporophore glows for only a few days early in its short life. The accompanying figure shows *Clitocybe illudens*, a species of American fungus with glowing sporophore.

Passing to the cœlenterate animals, or jellyfishes and polyps, we find the power of lighting very widespread. A great many jellyfishes and hydroids can glow, while a large number cannot do so at all. The forms that live near the coast are usually the ones that cannot, while the deep-sea forms living in great depths and the pelagic, or open-sea, kinds that live on the surface far from land are the species that show the power best.

These animals do not glow all over their bodies but only from certain epithelial cells, which may be scattered all over the surface or be collected more or less into groups or organs. Each of these light cells secretes luciferin in tiny granules and when the creature is stimulated, usually by some mechanical means, the luciferin is ejected into the surrounding water, doubtlessly accompanied by luciferase, and the lighting appears in the slime which covers the body. Thus, if one handles such a creature at night, the luminous slime comes off and shines on the hand and fingers. In the highest group of cœlenterates, the ctenophores, the power described is especially well developed and appears to be internal, but a closer study shows that it is certain of the epithelial cells lining the water canals that perform the function, which cannot, therefore, be considered to be internal. In these same ctenophores another important principle has been discovered by close study. The presence of any bright light stops or inhibits the whole process, nor can it be resumed until the animal has rested for some time (about a half hour) in the dark. If one brings ctenophores into the laboratory dark room from sunlit waters for study, he finds that for a half hour or so no light can be seen following any stimulation. Or if a lamp is lit for a few minutes and then put out, no light can be got from the creature for a time. Below is figured a jellyfish, as it appears when lighting.

Among the echinoderms are also found a few luminous kinds. No sea urchin, common star, or holothurian has ever been seen to emit light. Some crinoids have been reported as being able to do so; many of the brittlestars are known to do so very decidedly. Like the cœlenterates they have certain enlarged, unicellular glands on the sides of the arms that secrete luciferin, and when stimulated, these throw out their contents which stick to the surface and glow quite brightly.

Passing now to the worms, we find that several of the more highly organized kinds also can luminesce, and here for the first time we see that the power resides in well differentiated organs. The simplest of these in its lighting organization is the annelid worm *Chætopterus*, a large, highly specialized form that builds a tube in the mud and sand of shallow water in all the warm sea inlets and harbors of the world. It is about eight or nine inches long, of soft texture, and cream-white in color, with some parapodia specialized into long, trowel-like appendages for plastering a hard-setting mucus used to build and repair the parchment-like tube, with other parapodia formed into large paddles to create a current through the tube, and with simple posterior segments for developing and holding the reproductive cells or sperm and eggs. Various other

A luminous jellyfish, *Pelagia noctiluca*, from the Mediterranean Sea. It is depicted above in both the lighted and the unlighted state. From a drawing by Miss E. Grace White based on descriptions by the writer; first published in the *Journal of the Franklin Institute* queer appendages are developed on the body for unknown purposes, and the whole animal has a very queer appearance and hardly looks like a worm but rather like some very peculiar mollusk. The hollow tube in which it lives lies buried in the mud and is U-shaped, with the two open ends projecting a short distance above the surface. The tube is about fourteen to eighteen inches in length and is widest at its middle part.

Two views of the parchment worm (*Chætopterus*) after Panceri. On the right the animal is seen phosphorescing, the luminous portions of its body revealed. This worm is found along the seacoast in sandy mud, in which it excavates U-shaped tubes that serve as its dwelling place. It lines these tubes, the two ends of which are built up like protruding chimneys above the sea bottom, with a viscous substance produced by certain glands of its body. This substance hardens upon contact with salt water, taking on a parchment-like character that explains the name given its artisan. The body of the worm is divided into three main areas, indicated by the letters A, B, C in the picture on the left. The three disk-shaped segments embraced by the letter B, the first of which is indicated by an *f*, just fit the interior of the tube and constitute a pumping apparatus. As the worm rhythmically contracts, these segments act on the principle of the piston of a suction pump, causing a stream of water to pass in at one chimney and, after circulating through the tube, to pass out at the other. Through the stream of water thus set in motion many microscopic organisms on which the worm feeds are brought to it. These organisms are filtered out of the stream by the arms or wings, indicated by *e*, which, while the stream is being pumped through the tube, are arched about the hollowed cup, *d*. The mouth of the creature is indicated by *m;* the tentacles, which appear as bright, irregular lines on the luminous specimen, are indicated in the picture on the left by *c*.

In the Woods Hole Annulate Group in the Darwin Hall of the American Museum, the parchment worm is shown in its natural environment, while an enlarged model in a neighboring case brings out clearly the remarkable peculiarities of its structure

When at rest this organism is devoid of all light in the dark. But when a stimulus of any kind, either chemical or physical, is applied, it shines faintly or brightly according to the strength of that stimulus. The light begins as a series of peculiar violet or rosy glows that pass over the surface and then, with the stronger sorts of stimuli and according to the strength or vitality of the worm, ends as a bright, steady glow that may last for several minutes. This glow is very much stronger and lasts longer on certain appendages or parts of appendages than on the rest of the body.

A microscopic examination shows that, as in the cœlenterates, the light is produced by the secretion of thousands of single epithelial cells, or unicellular glands, scattered all over the animal's surface but much larger and more closely set on those parts where the light is strongest. These parts may be considered the light organs,—not very finished or highly specialized organs, but a marked step in advance. When seen in well-stained sections under the microscope, the cells look very much like those of the cœlenterates with their distal or outer ends filled with a mass of numerous, tightly packed, and round granules, which are the stored light substance.

In this case, too, as in the cœlenterates, the light appears only when the proper nerve impulse causes the cells to contract and throw few or many of these granules out into the surrounding layer of body slime, or mucus. While in the cell, they do not burn because they are kept free of oxygen. Once expelled, they rapidly oxidize and glow brightly. Two or three of these worms in a bucket half filled with fresh sea water, if irritated for a while, will discharge into the water so large a quantity of mucus mixed with luciferin that the entire amount of water will shine brightly for five minutes or more. The burning is comparatively slow and persists for some moments in contrast to the bright, sudden flash of a warm-water ctenophore. Two pictures of one of these worms are shown, one as it appears by daylight, showing its form and structure, the other as it appears in the dark, showing the location and extent of its chief light organs, or luminous patches.

The question now arises, to what end do these worms shine? Of what use is light to them or to the bacteria, the dinoflagellate protozoa, the fungi, or the cœlenterates? The question appears hopeless unless we consider the lighting merely as a sort of active coloration just as pigments are a method of passive coloration. Why do some few bacteria secrete yellow, blue, violet, red, and other pigments? Or some dinoflagellates red and brown pigments, or some fungi other bright colors? Even the usually transparent cœlenterates secrete bright colors on the surfaces of their bodies. It may be avoiding the question, but we can refer our problem of the uses of light to the larger one of color, and we shall see, if we pursue the study far enough, that the light so often appears in an organism under the same circumstances as does color that there must be a relation between the two. For instance, most animals have their brightest and most pronounced colors on their dorsal surface, leaving the ventral surfaces to show an evident lack of color, or lighter shade of color. In a majority of the luminous creatures the light appears in the ventral position, thus serving, in the dark, to give the creature a comparatively lighter underside. The light serves to color the animal in darkness where the ordinary colors would not show at all, but it colors it in a negative way. Later we shall see that

An eel hunting *Chætopterus* at night. The worm that is being seized is in full luminescence; another worm in a neighboring tube is beginning to light, stimulated by the commotion in the water occasioned by the attack of the eel. Drawing by R. Bruce Horsfall; republished from the *Journal of the Franklin Institute* it assumes a positive color function in some of the more highly specialized cases.

Owing to his habit of living in a tube underground, our friend *Chætopterus* is largely protected from the many animals that would otherwise be inclined to eat him. One species of little crab practically always lives in the tube with him though it never hurts him, and this crab is not known to live anywhere else. Some animals, however, do successfully attack and eat him. One is the eel, and a picture of the probable method of attack is shown on the preceding page. The worm has thrust his head up near one of the openings of his tube, and the eel, taking advantage of this position, has seized the head, tube, and all, and, breaking off the neck of the tube and discarding it, is pulling the worm out of his home. Usually the worm breaks so that the eel secures only a part of him. I have speared eels on a *Chætopterus* flat that have had in their stomachs a number of *Chætopterus* heads and even some whole worms. Although such an act of devouring has not been witnessed, the worm must certainly shine brightly while it is being eaten.

Another interesting annelid worm that lights is *Acholoe*, one of the so-called "scale worms." This animal lives on the sea bottom in moderate depths under shells and stones, and its long, slender, segmented body is covered by two rows of "scales," which are not scales at all but mushroom-shaped bits of flesh, two of them attached to each segment. The top side of each "scale" can shine, in this instance also from scattered epithelial gland cells, but the interesting feature is that if the body is cut in two in any place, whether by a pair of scissors or by a crab's claws, the anterior part will crawl quietly off while the posterior part will wriggle and shine brilliantly. If one excepts the shining, much the same is true of an earthworm. Physiologists know that if an earthworm be cut in two parts, the anterior end remains fairly quiet while the posterior part wriggles violently. The light in the case of *Acholoe* appears to share with motion a protective function in that the less useful part of the body is the more apt, through these demonstrations, to attract the attention of an attacking enemy, thereby permitting the essential part of the body to escape. Even single scales when detached will shine brilliantly. The frontispiece shows this phenomenon.

Another common little annelid worm, *Polycirrus*, seems to teach us a lesson in regard to the use of light. This annelid is short and fleshy and lives on European coasts in large numbers, crawling under the edges of seaweed-covered stones or burying itself in gravel. It protrudes its head only, which is surmounted by a thick bunch of long, slender tentacles. During the daytime these tentacles appear of a bright red or orange yellow color in different individuals while the body is a dark muddy brown. In the darkness the tentacles shine brightly, but the body always remains dark. Now let us note another and related fact of interest: if you place such a worm before a hungry fish, the latter will sometimes seize it, but will always spit it out again. If you cut off the head with its tentacles attached, the fish will seize and swallow the headless body, but always reject the head with its tentacles. The tentacles are distasteful to him and the bright red or yellow color is a warning coloration. So also is the luminosity.

Yet another annelid worm can teach us an interesting lesson. This is the tropical marine annelid *Odontosyllis*, an inhabitant, among other places, of the waters of Bermuda. The light organs of this worm are highly specialized structures developed from other specialized organs found in annelid worms, the setæ or body spines. We find setæ on the parapodia of nearly all annelids. They give the "roughness" to an earthworm or act as the poisonous barbs of some marine forms. They are made of a substance called chitin by a set of cells developed from the epidermis and called the setigenous cells. In *Odontosyllis* certain of the ventral setigenous glands instead of secreting chitin to form setæ make granules of luciferin, while neighboring groups form luciferase. These two substances are thrown out together under the proper stimulation and illuminate in the water.

These worms live in crevices of the coral rock for nearly all of their lives. But at certain times in the summer—very exact times—they come forth to lay their eggs. The eggs and sperm are deposited on the surface of the sea and the eggs thereby become fertilized. The time for spawning has an exact relation to the time of the full moon combined with a slighter influence that may be attributed to the relation of the tide to the time of day.

Galloway gives the dates of the appearances for spawning purposes during the summer of 1904. These dates were: July 3–7 (maximum on July 4), July 29–31 (maximum on July 30), August 31. The display, as seen from the wharfs, lasted about one half hour and was as follows: Just as dusk was becoming pronounced, the females, which evidently had swam up from the depths without showing any light, suddenly began to display their glow, swimming rapidly on the surface in circles about two to three inches in diameter. Each left behind her a glow caused by the faintly luminous eggs and the much brighter luminous secretion from the light-producing glands. If the male failed to appear, the glow ceased after ten or fifteen seconds.

The male is first seen as a distant

The marine worm, *Odontosyllis*, lives for the greater part of its life in the crevices of coral rock. At certain definite times during the summer, however, it issues forth and comes to the surface of the sea. There the female, as she swims, deposits her eggs. These eggs are themselves mildly luminous, but, in addition, the female discharges from her light-producing glands a secretion that glows for from ten to fifteen seconds and apprises the male of her presence. Drawn by Miss E. Grace White after the descriptions of Galloway and Welch, Cary, Linton and others, and originally published by the *Journal of the Franklin Institute*

A marine copepod much enlarged. This little creature, when stimulated, gives off light substance from several points on its body. The position of the glands that secrete substance of this character is indicated by the letter *l*. (After Giesbrecht.)

glint of light in the deeper water and headed toward the glowing female. He comes up rapidly and when the female starts one of her short periods of shedding eggs and light substance, he darts to her and they swim together in somewhat wider circles, she scattering eggs and he sperm into the water.

Light may be evoked from either of the parent worms by the usual form of stimuli even though they have been captured after the eggs and sperm are all shed. The picture on p. 13 gives an idea of how these worms would appear from beneath if the observer, looking upward through the glass side of the aquarium, were to see them spawning.

Passing by some other interesting kinds of luminous worms, we will now consider the Crustacea, which have very curious, light-producing members. Perhaps the best known luminous forms are a few of the many hundred species of copepods, very small crustaceans that are found in both fresh and salt water. On account of their size and active movements these are often called "water fleas."

None of the fresh-water kinds can produce light. Among the salt-water species which swarm on the surface of the ocean, a few, as Professor Giesbrecht, of Naples, has shown, are able to give a tiny, bright spark at certain times of the year, probably during the breeding season.

Giesbrecht found it very difficult to prove that any particular copepod was capable of producing light or lacked this power. By pouring sea water containing the tiny animals on to a cheesecloth screen and then rapidly examining the layer of kicking, struggling creatures with a magnifying glass, he was able finally to pick out four kinds that did emit one or more tiny sparks. He put these under the microscope and was further able to see that the light came from several spots, always the same, on the body or limbs. A careful examination of these spots then showed that each was a tiny gland with an opening through which the luciferin was thrown when the animal was stimulated either mechanically or chemically. Thus he found that the copepods, or such of them as could light, produced their flash outside of their body,—a method that is not found in all of the Crustacea by any means as we shall see. One of these minute forms is shown much enlarged. The picture indicates the position of the glands that secrete the luciferin (and undoubtedly also the luciferase).

The next luminous crustacean that we will examine, a very remarkable one, illuminates in a very different way. This animal is one of the group Schizopoda, small shrimplike forms found all over the world, especially in the sea. Two principal forms occur: the Mysidæ, which usually live nearer shore and on the bottom, and the somewhat larger Euphausidæ, which are found in waters farther from the shore and tend to swim up off the bottom, sometimes near the surface. It is reported that the *Mysis* forms sometimes give light, but no definite work has been done to prove this fact or to indicate any structures that might possibly be light organs. On the other hand, we know that the Euphausidæ have some of the best developed light organs that are known, and in studying them we will find for the first time some of the interesting accessory tissues and organs that are used to intensify, color, and direct the light, as well as to protect the other tissues from its rays.

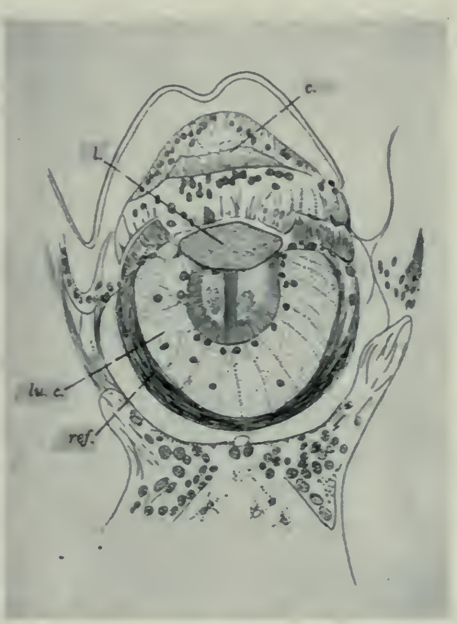
The general effect of all these accessory tissues on the appearance of the light organs is to make them resemble eyes on superficial examination. In fact, long before their true nature was recognized, these organs were described as accessory eyes by some of the best known students of the group.

There are usually ten of these organs, but they occur in lessening numbers in some of the simpler forms. Some Euphausidæ have only four or even two, and others, for instance certain species of *Stylochiron*, have none. For our purpose we will study the common species, *Nyctiphanes norvegica*, found near most shores of the North Atlantic Ocean and easily procurable for study at most biological stations.

This small shrimp has ten light organs: one on each of the two eye stalks; four on the thorax, two of which occur on each lower lateral edge; four others on the median ventral line of the abdomen. Each light organ is a round, slightly protuberant mass, and seems to be capable of a slight, rolling motion, as well as a change of position and direction due to the movements of the limbs near which it is placed.

If one examines an axial section of this organ under the microscope (see accompanying picture), many details of its structure become clear. The inner, hemispherical surface is covered outwardly by a double layer consisting of a very thin outer envelope of pigment, which naturally keeps all light from passing into the body tissues, and an inner part composed of a thick covering of reflector cells in which has been secreted some substance that reflects any light which may strike the layer. Thus the body tissues are doubly protected from light, but one naturally wonders why the pigment is present at all, if all the light is to be reflected or turned back before it gets to this layer. Still we repeatedly find this arrangement in so many different light organs of independent origin that some good reason must exist which may some day be explained by further study.

Within the concavity of the reflector comes the thick, fleshy, cup-shaped mass of the light cells (*lu.c*) in which the granular luciferin is secreted. These cells extend from the reflector (*ref*) to the inside of the cup in most cases, although a few of them are shorter. Their nuclei are large, round, and dark-staining, and running between the cells and through them are a number of blood capillaries, the course of which is shown by the light streaks in the drawing. The size and number of these capillaries would seem to indicate that they bear the supply of oxygen that is used to burn the luciferin when the light is emitted.



Axial section of the light organ of a shrimp, *Nyctiphanes norvegica: ref.*, reflector; *lu.c.*, light cells; *l*, lens of chitin; *c*, cornea. From Dahlgren and Kepner's *Histology*. After Valentine and Cunningham

In the hollow of the cup formed by the

light cells lies the peculiar mass of long, thin rods the purpose or use of which remains up to the present a puzzle. Most of them are arranged in a radial fashion, while two smaller masses lie horizontally within the cup. These are indicated in the drawing, where they are seen in cross-section, by two oval patches of dots. Much interesting work remains to be done on these in order to determine their function.

Immediately in front of the rod-mass lies the chitinous lens (*l*) the function of which is clear from the position, shape, transparency, and refractive qualities in the living animal. This lens is fixed in form and is immovable in position. The wide, flat, and circular cell in front of it would appear to be the cell that forms and supports it.

In front of this cell and closely adhering to it is the wide, flat, and somewhat thick cellular lens, or outer lens, the use of which has been guessed at, and probably correctly, by the presence of a ring-shaped mass of what is probably muscle tissue. This mass is in a position to thin out the outer edge of the outer lens and thus alter its focus. It has been called by Trojan the lamella; work must be done on its structure and chemical reactions as well as observations made on its actual behavior during life to prove that it really is muscle tissue.

Next comes a wide blood space, always filled with the blood plasma, and outermost of all the cornea (*c*), made up of a somewhat specialized area of the easily understood hypodermis with its usual cuticle.

Here we have a remarkably complex and specialized organ with reflector and pigment layer, two lenses, and some unknown structures that can be used at the will of the animal and are so used when the creature is disturbed or stimulated. What the normal useof this organ may be in life we do not yet know,—possibly a sex attraction or to warn enemies or to find food or merely to color the ventral surface of the creature. The light is of the usual greenish yellow tinge seen in most luminous creatures. Nothing is known of its development, which should be very interesting. The light does not flash but burns for some seconds or minutes with a steady glow. It is internal, but whether it appears in the luminous cells or in the rod-mass is also not known.

Other groups of deep-sea shrimps or prawns, the Penæidea and Caridea, have much simpler light organs of dermal origin and produce their blue or violet light by internal combustion.

Still another large group of deep-sea prawns, as represented by *Heterocarpus* and *Aristeus*, have a totally different method of lighting. They possess a large number of glands opening by fine ducts into the stream of respiratory water, so that, when the animal is stimulated, the luciferin is ejected into this stream and is thus blown out in front of the organism in clouds of light. Mr. Welch has described to me a species in which the clouds of light material assume the form of rings much like the smoke rings blown out into the air by a human smoker (see p. 21).

Perhaps one of the most interesting of all the light-giving Crustacea is the tiny ostracod, *Cypridina hilgendorfii*, that is found in Japanese waters. Its Japanese name translated into English signifies "marine firefly" and when disturbed it gives out powerful, if small, flashes of a bright, blue light with no trace of green or yellow as in most forms. The light substance comes from unicellular glands in the body that open on the upper lip. An important point here is that there are several kinds of these glands, and that we can in this case distinguish the luciferin from the luciferase in the several parts of the gland. This condition is a rare one among the known luminous forms and has made *Cypridina* available for the most important chemical studies of luciferin that have yet appeared, those by Dr. E. N. Harvey.

Various other crustaceans have been dredged up out of deep water by the "Challenger," the "Valdivia," and other deep-sea expeditions, but they have not been carefully studied. One large crab had large, superficial patches of light on its lower surface.

The insects, close relatives of the crustaceans, have certain luminous members. The common occurrence of some of these insects in our fields and on our lawns are well known to man,—better perhaps than any other light-giving animals. One case of luminescence is found among the primitive insects called collembolids. Several species of these, very minute in size and living in old manure, dead leaves, and in alluvial gravel in the river valleys of our eastern and southern streams, can emit a small, short glow. In this case the light comes from all the hypodermal cells which cover the body and form the cuticle or skin. Here the luciferin appears as well-formed granules in the cells, and the method of lighting must be the same as that seen in so primitive an animal as *Noctiluca*.

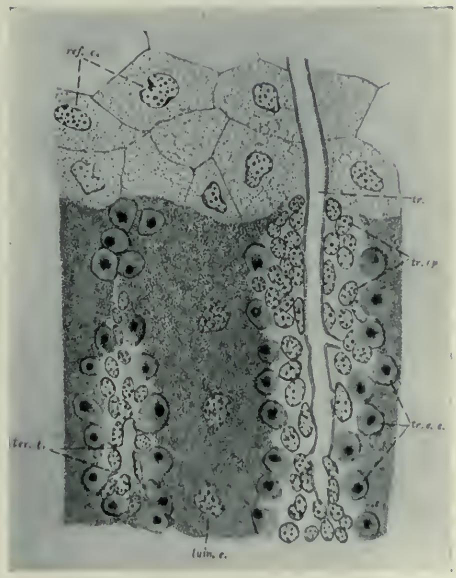
Another luminous insect is a fly found in Australia and New Zealand. Both larva and adult show a glow in the interior of the body. The glow comes from the cells that constitute the distal ends of the Malpighian tubules, which are, in fact, the fly's kidneys,—a remarkable modification that shows us from what diverse sources the light cells can be derived.

The best known insects are the fireflies and glowworms of our own and practically all other countries, and the fire beetles, or cucujos, of the tropics.[1] In all of these insects, which belong to two families of beetles, the Lampyridæ and the Elateridæ, it seems that the light cells are derived from modified fat bodies,—one of the few cases where mesodermal elements have been used for this purpose. Their structure shows the common principle of a layer of light cells near and next to

The fire beetle or cucujo of South America. The beetle is luminous, shining by means of light organs located in the lower corners of the thorax and clearly seen in the case of the specimen reposing on the leaf. A third large light organ on the ventral side of the abdomen is more rarely used, and probably only as a mating signal. (From Mangold.)

the integument, a transparent cuticle at that point, and a layer of reflector cells filled with crystals of calcium urate, which throw back the light so that all rays are directed outward. The oxygen is brought to the cells by the numerous tracheal capillaries that come to the organ and, according to the amount of control of this air supply, we find either a slow glow, as in the larvæ of the lampyrids (called glowworms) and in both larvæ and adults of the cucujos, or we see a quick, sharp, well-timed flash or series of flashes, as in our common fireflies, where the flashes are used by the insects as a distinguishing mark of their species in finding their mate among the mates of several other species all flashing at the same time. In these latter cases the end branches of the tracheal stems that carry the oxygen (air) into the light cells are provided with a radial muscle apparatus that not only controls the flow of air but actually can pump spurts

[1] See p. 89 of this issue.



The cucujo, shown in the preceding picture, belongs to the family of beetles known as Elateridæ. There is another family of beetles, the Lampyridæ, many of the members of which luminesce. Above is shown a vertical section through the light organ of a firefly, *Photinus*, one of the Lampyridæ. The lettering has the following significance: *tr.*—trachæ; *tr.ep.*—tracheal epithelium, *tr. e.c.*—tracheal end cells; *ref. c.*—reflector cells; *lum. c.*—luminous cells; *ter. t.*—terminal twigs of the trachea. From Dahlgren's and Kepner's *Histology*

of air into the light cells. The illustration shows some of these air-controlling muscle cells, which are called tracheal end cells.

The lower Mollusca come very close to having no luminous members among their vast aggregation of species. Only one bivalve, *Pholas*, and one gastropod, *Phyllirrhöe*, can produce light. The highest and most specialized order of all, however, the cephalopod mollusks, show a very large number of members that are brilliantly illumined by internal combustion or that can spout streams of light into the water. Although these squids can illuminate so beautifully, their cousins, the octopi, show no luminous forms so far as known. Whether the ancient tetrabranch cephalopods could produce light we do not know.

The bivalve (pelecypod), *Pholas dactylus*, may be spoken of as the only luminous clam. It is elongate and bores a burrow-like home in the hard mud in all tropical seas. Its siphon reaches to the surface and in all other ways it feeds and breathes and acts exactly like an ordinary soft clam. If we open it with a knife and examine the interior of its mantle chamber, which is in reality an outer surface of its body, we shall find three pairs of symmetrical, whitish, and swollen glands: one pair, long and cordlike, in the siphon, placed one on each side; another pair, compact and triangular in shape, placed one on each side of the visceral body mass; and a third pair, long and cordlike, placed on the posterior edge of the mantle in such a position that glands adjoin in the median line, thus forming a single, long structure.

In a dark or semidark room these gland masses shine with a vivid green light that drips from them and is easily washed off in sea water or rubbed off on the fingers; more luminous material appears on the surface. A microscopic examination shows that each gland mass consists of thousands of unicellular glands, derived from the surface epithelium but sunk far beneath its general contour. We find two sorts of such glands, one sunk farther than the other, thus forming two layers. One kind secretes luciferin, which appears as round granules of considerable size, while the other secretes a mixture of luciferase and mucus. Since the gland cells open on the surface all together, their contents mix when the integumentary muscles squeeze them out and, meeting oxygen in the sea water, result in a brilliantly luminous mucus. We do not know the purpose for which they are used.

The gastropod, *Phyllirrhöe*, is a very specialized form of this group and unlike most of the other members, which have a heavy shell and live on the sea bottom or on some object on which they can crawl, *Phyllirrhöe* is adapted for a life on the surface of the open sea. Like many plankton animals it is almost wholly transparent. Its body is compressed into a decidedly fishlike shape with the posterior end enlarged into a fishlike tail. It swims with a fishlike motion, but more clumsily.

In the dark it gives out light whenever stimulated by touch or chemical means. The light comes from the entire surface of the body, and upon microscopic examination one finds many scattered unicellular glands, mostly in pairs or threes or fours, which secrete the necessary luciferin and luciferase. These glands are supplied with large nerve fibers.

The squids are among the most brilliant of our luminous animals. There are so many forms that illuminate that we are forced, for lack of space, to mention but a few typical forms. *Watasenia scintillans* occurs, like most of the light-giving squids, in deep water. It lives in the deep water of the Sea of Japan for most of the year, but during a period of two weeks or more it appears in huge schools near the shore for the purpose of laying its eggs. The masses of squid sparkle and flash in the water in the most brilliant manner, showing a fine, bluish light. An examination of the body of one of them discloses more than four hundred light organs of small size scattered all over the body (mantle), mostly on the ventral surface. These are organs of internal combustion. The principal lights, however, are six in number, three in a row in the tissues of each of the two longest arms. In the dead squid these look like black or bluish lumps seen through the skin. A section of one shows that each is a collection of large cells, from 75 to 100 in number, closely packed together, with the limits of each cell rather hard to see. Through this mass runs an abundant supply of capillaries, some of which appear to penetrate the bodies of the cells themselves. With proper stains we see that the cytoplasm of the cells is filled with very large cylindrical granules of luciferin regularly spaced. The light evidently comes from the oxidation of the outer layers of these large granules. Outside of each organ and covering it as a layer of leaves are large, overlapping, black chromatophores or pigment cells capable of a rapid contraction and expansion at the command of an abundant nerve supply. When the organ is lit up, these chromatophores cause it to flash by their rapid contraction, and cut the light off again by expanding.

Another squid, *Thaumatolampas diadema*, lives in water more than a mile in depth, and has twenty-two light organs, round in shape, on its body. Two of these organs show a ruby-red light, two a sky-blue light, and one an ultramarine-blue light. All the rest are white; an examination seems to indicate that all the lights are in reality white lights and that when they show color, this color is due to a screen formed by a transparent, colored chromatophore, which lies over the white light and gives it its hue.

Still another squid lives on the surface of the seas about Italy and other Mediterranean countries and gives out light in an entirely different way. It has two light glands near its ink-sac and the cavity, or reservoir, of each of these glands becomes filled with a mixture of luciferin and luciferase. If struck or irritated by a glass rod, the animal squeezes the glands and the pasty mixture is forced out of several small holes like tooth paste from a tube. The secretion breaks off in little rodlike sections and, becoming caught in the mucus from some neighboring cells, the whole mass is swept out through the siphon, by the respiratory stream of sea water. As the mucus swells and the oxygen-bearing water gets into the mass, a very brilliant light is emitted.

Hundreds, or perhaps thousands, of species of fishes shine in the water by their own light. While the greater number of them live at great depths,[1] a fairly large number are found dwelling among the plankton on the surface, and a few live on the shore bottoms under stones or in the sand. For want of space we can mention only a few examples.

[1]See p. 86 of this issue

LUMINOUS SHRIMPS

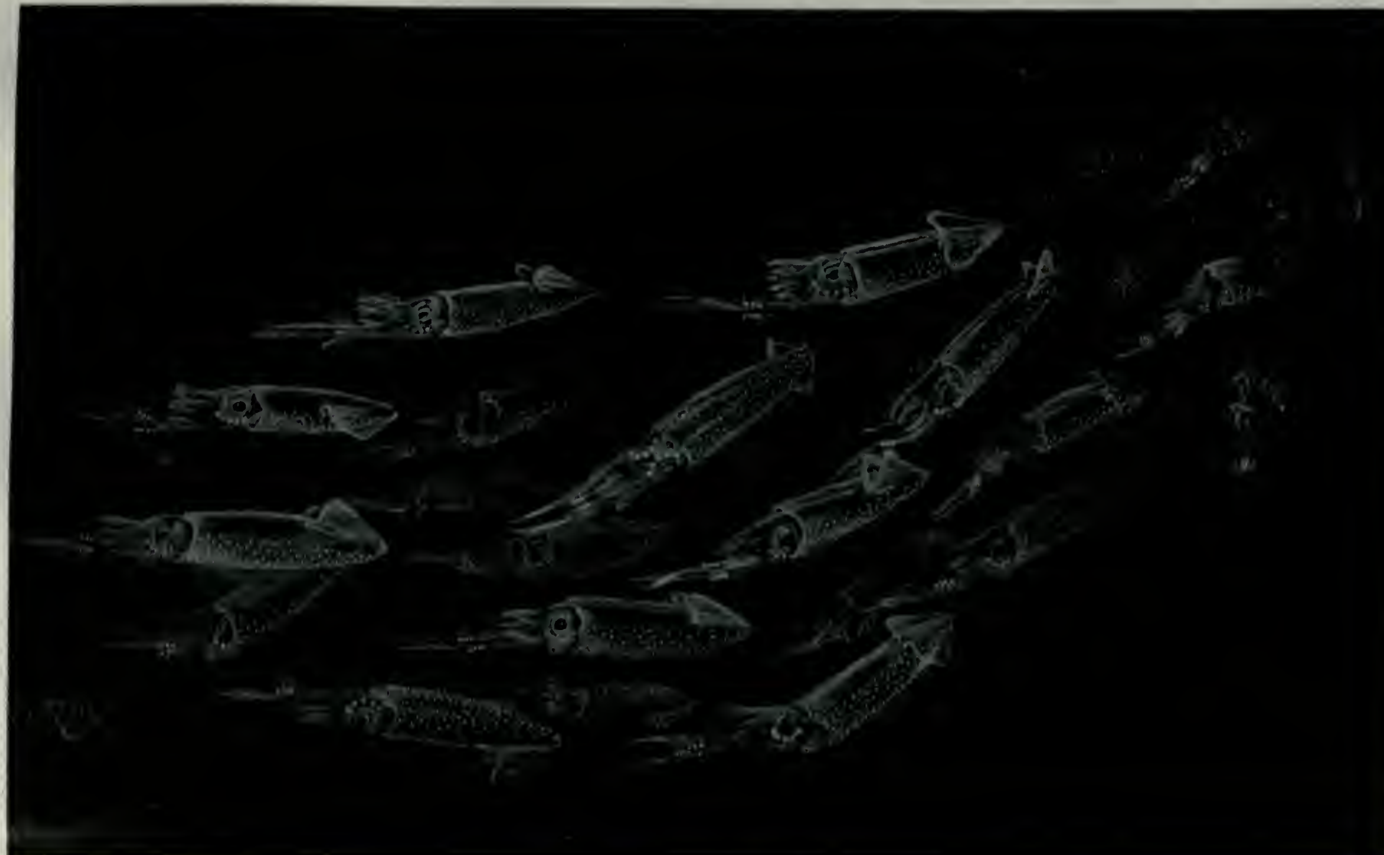
They are swimming among seaweed in the proximity of an old stone pier. From a drawing by R. Bruce Horsfall based on descriptions of the writer and originally published in the *Journal of the Franklin Institute*

DEEP-SEA PRAWNS

The heavy, ringlike clouds of light substance emitted by certain deep-sea prawns suggest the smoke rings blown forth by someone idly puffing a cigar. Original drawing by Miss E. Grace White, after descriptions by Alcock and W. W. Welsh. Reprinted from the *Journal of the Franklin Institute*

PELAGIC GASTROPODS

These gastropods (*Phyllirrhöe*), living on the surface of the open sea, have a fishlike shape and are almost wholly transparent. Some of these specimens in the picture show the lighting condition. Drawings by Miss E. Grace White after descriptions by Panceri, Trojan, and the writer



A SCHOOL OF DEEP-SEA SQUIDS

It is in the waters of the Japan Sea that *Watasenia scintillans* is found. The picture shows the different types of luminous organs possessed by this creature. Drawn by Miss E. Grace White after descriptions by Sasaki and others and first published in the *Journal of the Franklin Institute*

Certain small, black sharks living in very deep water have the lower surface studded with thousands of small, even microscopic, lights that give the effect of a bright, steady glow all over this surface. These forms are found in nearly all seas at depths of from 500 to more than 1500 fathoms. The glands are epithelial but of an internal form of combustion. One of these sharks, *Spinax niger*, is pictured above.

Far below the surface of the sea, in depths ranging from 500 to more than 1500 fathoms, where perpetual darkness reigns, live certain small, black sharks that luminesce. Two specimens of such a shark, *Spinax*, are shown in the picture above. The light comes from thousands of minute epithelial organs in the skin of the ventral area. The combined effect of these microscopic lights is that of a bright, even glow over the lower surface of the fish. Drawn by R. Bruce Horsfall after descriptions by Johann, Beer, and the writer

Another common luminous fish is found in all seas on the surface, sometimes in large schools, at other times singly or scattered in groups. This is *Maurolica*, a genus including several species all much alike. It has a small, herring-like form, usually about three inches long, and shows several close-set rows of light organs, round in shape, on its ventral surface. These organs are typical of the light organs of so many other teleost fishes that we are impelled to describe them. The outer surface, composed of the outer epithelial cells of the skin, is lens-shaped and slightly protruding. Beneath this comes the main mass of the light cells which extends downward somewhat below the inner surface of the general epithelial layer and consists of the inner epithelial cells of this region. These epithelial light cells are large and secrete the luciferin, which (as two or three groups of granules) is contained in little pockets in the cytoplasm touching the surface of the cell. The light is produced by internal combustion, the luciferin being oxidized *in situ*.

Behind this mass of light cells, which

includes the basal layer of the stratified epithelium, comes the reflector, which is a cup-shaped layer of connective tissue, the platelike cells of which are filled with tiny crystals of some organic substance, probably guanin, that collectively have the power of reflecting light. Even after fixation, staining, and mounting in balsam, this reflector continues to throw back the light from a thin section so that it forms a bright, silvery layer on the mounted slide. The reflector is lined on its back surface with a thin layer of black pigment cells, which further prevent the light from passing into the tissues of the body.

Light organs of this essential structure, but of various shapes and sizes, and placed on all parts of the body, though usually on the ventral surface, are found on nearly all the other luminous teleost fishes. It remains to describe a teleost fish, *Photoblephron*, which has evolved a method of external combustion. It is found in the Pacific Ocean around the Island of Banda, where it was studied by Weber and later by Harvey.

Several individuals of the luminous fish, *Photoblephron*, are shown in this picture. The light is continuous and beyond the control of the fish, burning by day as well as by night. However, there is a curtain of black pigment which can be pulled down over the organ, thereby shutting off the light. The luminous organ retains its brightness even when removed from the fish, and anglers of the island of Banda, off the coast of which the fish is found, put this organ on their fishhooks, using it as a night bait. Drawn by R. Bruce Horsfall from descriptions by Weber and Harvey

This fish has two light organs, one under each eye. The organ is large and is furnished with a reflector and inner pigment mantle almost exactly like the organ just described. The light cells are composed of epithelial cells of the basal layer, and this is invaginated into a series of tubular glands at right angles to the skin. The luciferin is not secreted in the cells but is found in bacteria living in the tubules and this mass of bacteria passes outward, being continuously expelled into a series of pockets just under the outer layer of the skin, several glands or tubules emptying into each pocket. These pockets are not closed but each has one or more small openings to the exterior, admitting a small amount of fresh sea water which carries with it the free oxygen necessary to combustion and the production of light. Thus the light is in this instance not subject to nerve control but burns all the time, night as well as day. In order to shut off the light, however, there is a black mantle like a third eyelid, which can be pulled down over the whole organ, the latter turning up and inward to facilitate the operation. In consequence the light can no longer be seen.

This organ is often cut out by the fishermen of Banda, who use it as a night bait for fishing. It is tough and will stay burning brightly on a fishhook for a long time.

Several Lophius-like, pediculate, deep-sea fishes have organs, built on this general plan, on the end of their "fish-rod," or anterior dorsal fin spine, and use these as does the well-known "angler" or "monk-fish" in angling for its prey.

A whole volume could be written in describing other forms of light-producing animals and their light-producing organs. It is hoped, however, that this short account will reveal in small measure what an interesting field for study lies waiting for a solution of its many problems.

Region of the eastern Pyrenees. The writer's automobile tour passed through Carcassonne, Perpignan, Mont Louis, Font-Romeu, the republic of Andorra, and Ax-les-Thermes to Foix and Saint Girons. Ten kilometers north of Saint Girons is the estate of the Comte de Bégouen including the limestone mountain which contains the cavern of Tuc d'Audoubert and Les Trois Frères

THE BIRTH OF SCULPTURE IN SOUTHERN FRANCE

BY

HENRY FAIRFIELD OSBORN

"Après l'examen souvent trop aride des vestiges purement industriels de nos ancêtres les plus anciens, l'apparition des premières œuvres d'art est à l'archéologie ce qu'est à la vie de l'homme le premier sourire de l'enfance."

"De nos provinces du sud-ouest qui nous apparaissent comme le foyer et le centre de dispersion de cette civilisation, l'art magdalénien se propage au nord et à l'est. A mesure qu'il s'éloigne des rives de la Vézère ou des cavernes pyrénéennes, il perd peu à peu sa fécondité, tout en conservant les traits essentiels de ses caractères et de son originalité."—JOSEPH DÉCHELETTE, *Manuel d'Archéologie*, 1908.

IN SO far as Europe is concerned, it would seem that the art of sculpture had its birth in the imagination of men of the Crô-Magnon race, who, about twenty-five thousand years ago, occupied a large part of western Europe, their art attaining its most intensive development in two regions, namely, the region now known as Pyrénées-Languedoc and the valley of the Vézère in Dordogne. The former region—with the historic centers of Albi in the north, Montpellier and Perpignan along the Gulf of Lyons, the walled city of Carcassonne in the center, the frontier post of Mont Louis and the diminutive republic of Andorra in the south, the mystical grotto of Lourdes on the west and the fashionable baths of Luchon and the glacial cirque of Gavarni—is a veritable encyclopedia of the history as well as of the prehistory of France. The latter region, about one hundred fifty miles to the north, embracing the valley of the Vézère in Dordogne and the adjacent districts, includes the rock shelters of Laussel and Cap Blanc with sculptures of monumental size.

Prehistoric painting, which attained a notable development in both these regions, also reached a high level in the grotto of Altamira and other caverns of the Cantabrian region in northern Spain, but nowhere else are the treasures of prehistoric sculpture so abundant as in these two regions, where a number of the foremost masterpieces of this Palæolithic art have been discovered. The accompanying list[1] of some of the best known of these treasures will serve to show their geographic distribution, and the grounds for the preceding statement.

PYRÉNÉES-LANGUEDOC REGION	
Mas d'Azil	Human figurine, horse head (with flesh removed) in reindeer horn, head of horse in act of neighing, swan, mammoth, head of flayed equine
Brassempouy	Female figure, woman's head with headdress
Lourdes (Les Espelugues)	Horse in ivory
Tuc d'Audoubert	Male and female bison modeled in clay
VEZÈRE REGION	
Laugerie Basse	Human figurine, bovines, reindeer, mammoth head, bison head, and various animals
Teyjat	Horse head carved in lignite
Les Eyzies	Human statuette
Laussel	Four large human figures in bas relief
Raymonden (Chancelade)	Horse head in reindeer horn
Cap Blanc	Six horses cut in limestone on the cliff wall
Comarque	Horse head (bas relief)
Gorge d'Enfer	Salmon (bas relief) on the roof of the cave
FRANCE, Other parts of	
Bruniquel	Reindeer
La Trilobite	Beetle
BELGIUM	
Trou Magrite	Human figurine
ITALY	
Grimaldi	Female figurine in soapstone
SWITZERLAND	
Kesslerloch	Various sculptures
MORAVIA	
Brünn	Human figurine in ivory

The present article is the outcome of the writer's delightful visit to the Pyrenees and Dordogne regions in 1912 and to the Pyrenees and the collections of Laussel in 1921. In 1912 the author had the good fortune to visit the Comte de Bégouen at his home near Saint Girons twenty-two days after the discovery of the *galerie inférieure* of the cavern known as Tuc d'Audoubert. The accompanying photograph shows the entrance of this cavern—which is on his estate—exactly as it appeared at the time of its discovery. The central figure holding a cane and standing by the edge of the rivulet which issues from the cavern is the Comte de Bégouen; by his side is his eldest son, who has in his left hand one of the acetylene lamps used to light the difficult journey through the cavern; in the background are the two younger sons in a small boat of their own manufacture in which they followed the stream for a distance of two hundred feet when they made the original discovery. The writer returned in August, 1921, to find the Comte de Bégouen more full of energy and enthusiasm than ever, and ready to act as guide to the *galerie supérieure*. In the interval his

[1]Compiled chiefly from the *Manuel d'Archéologie* of the lamented Déchelette, and amplified from Burkitt's *Prehistory* and de Morgan's *L'Humanité Préhistorique*.

Entrance to the cavern of Tuc d'Audoubert in the foothills of the Pyrenees near Saint Girons, with the Comte de Bégouen and his three sons as they appeared two days after the discovery of this cavern in 1912

The Salle Cartailhac, named in honor of the late Professor Emile Cartailhac of Toulouse, the finest chamber in the interior of the cavern of Tuc d'Audoubert. Photograph by permission of the Comte de Bégouen

Salle des Bisons. The bull (left) and the cow (right) bison sculptured from the red clay found on the floor of the adjoining Salle de Danse in the cavern of Tuc d'Audoubert. Photograph by permission of M. Jean Brunhes

three sons had safely emerged from the hazards of the war with decorations for gallantry.

In the early summer of 1914, before the beginning of the fatal World War, these three lads had observed a very small opening in one of the side walls of the *galerie inférieure* through which they were barely able to squeeze their slender bodies. Undaunted by difficulties, they pushed onward along what is now known as the *galerie supérieure* into the superb chamber of stalactites, subsequently designated the Salle Cartailhac—in honor of Professor Emile Cartailhac, the veteran archæologist of Toulouse, whose death after a long and honorable career as the dean of French archæology has recently been announced.[1] From the Salle Cartailhac openings lead in several directions—in fact, on the occasion of the writer's recent visit the party nearly lost its way in this part of the cavern on the return trip. The labyrinthine nature of the cavern and the extreme narrowness of the passages failed to deter "*les trois frères*." They courageously pushed their way onward and upward, wriggling like serpents through narrow spaces, until after a final, most difficult passage, the narrowest of all, they entered a chamber 50 feet long and 30 feet across with a ceiling about 12 feet high. On the floor at the end of this chamber they found traces of a small circle built of stones, and could hardly believe their eyes when their lanterns flashed upon a pair of bison modeled in clay, consisting of a cow in front and a bull following, both leaning with the left side against a large mass of clay. One of the most astounding discoveries in the whole history of French archæology was thus made through the courage and enterprise of these three lads—namely, that the sculptors of Palæolithic times were familiar with the use of modeling clay and employed this as a medium of expression and perhaps even for prelimin-

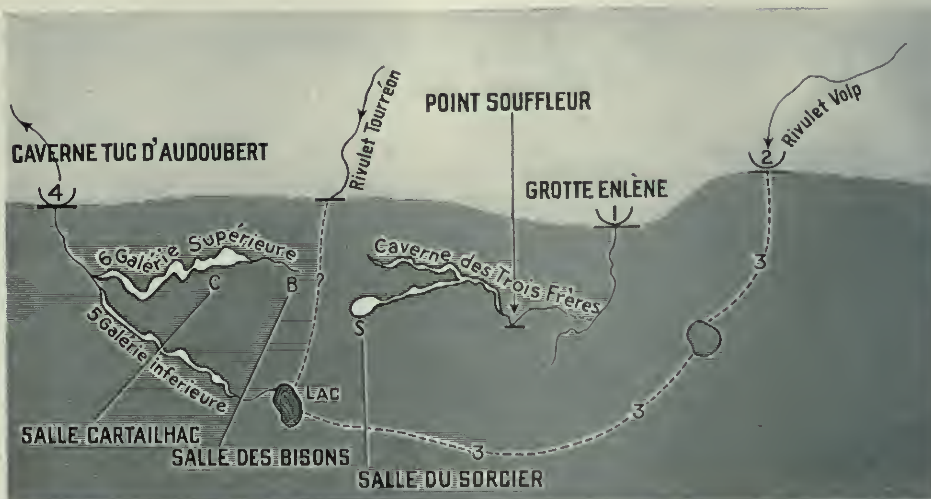
[1]See p. 92 of this issue

ary study of works subsequently to be executed in the more enduring medium of stone, exactly as our sculptors do today. They were also extremely skilful in the use of this clay and the photographs taken with the acetylene light convey little idea of the extraordinary accuracy of the great lines of musculature indicated in the fore quarters, neck, and head.

The lads did not tarry to make such detailed observations as these, but hastened back to announce their discovery to their father; and to our mind the courage which the sons displayed was less remarkable than that of their father, who immediately returned to make the same, most difficult ascent. How the Count ever succeeded in forcing his stalwart figure through the narrow passages—impossible to any but the most accomplished 'cavernist'—we cannot imagine. At the time of our visit in 1921 iron ladders, steps, and other aids to the ascent had been prepared, and inconvenient masses of limestone had been chiseled down; but notwithstanding such provisions the ascent was the most difficult and arduous of its kind that we have ever undertaken. At one point it was necessary literally to crawl upon one's face—'*ventre à terre*'—and when halfway through to turn on one's side because the two pillars of limestone are too close to allow the shoulders and hips to pass. Our admiration of the Comte de Bégouen increased every moment. When finally we emerged into the Salle des Bisons, we were completely out of breath but spiritually prepared for the greatest impression of our life, namely, the sight of an atelier preserved exactly as it was left by the prehistoric sculptors twenty-five thousand or more years ago, with the bison still soft to the touch and the mass of clay as yet only slightly contracted by dessication, exhibiting two vertical cracks in the figures, which are clearly shown in the accompanying photograph by M. Jean Brunhes. The mass of clay against which these bison lean is also clearly shown. The tail of the right-hand (female) bison has dropped to the ground. On the other side of the mass of clay is a third, uncompleted figure of a bison, and a model of a fourth partly finished. Near by are several rolls of fresh clay, indicating that this material was carefully worked before being applied to the model. It is impossible to convey any idea of the impression made upon our mind by the Salle des Bisons and especially by the two central figures which give it its name. As the light from the lantern is slowly passed round these scu'ptures, one realizes that they are triumphs of impressionism. The effect is one of suggestion conveyed by strong, sure strokes of the modeling tool. There is absolute truth of proportion, and to this all matters of detail and retouch are subordinate.

Not far distant is a small, depressed chamber where one can observe fresh prints of hands and feet—the footprints being of very delicate type, deeply impressed into the fresh clay, and subsequently covered with a very thin coating of limestone. This recess is called the Salle de Danse although there is no evidence of any such ceremonial having

Heel-cast from the Salle de Danse adjoining the Salle des Bisons in the cavern of Tuc d'Audoubert. Presented to the American Museum of Natural History by the Comte de Bégouen. One third actual size



Plan of the interior of the limestone mountain of Tuc d'Audoubert on the estate of the Comte de Bégouen, showing the location of the caverns and their entrances and the supposed course of the subterranean streams; redrawn from a sketch by the Count

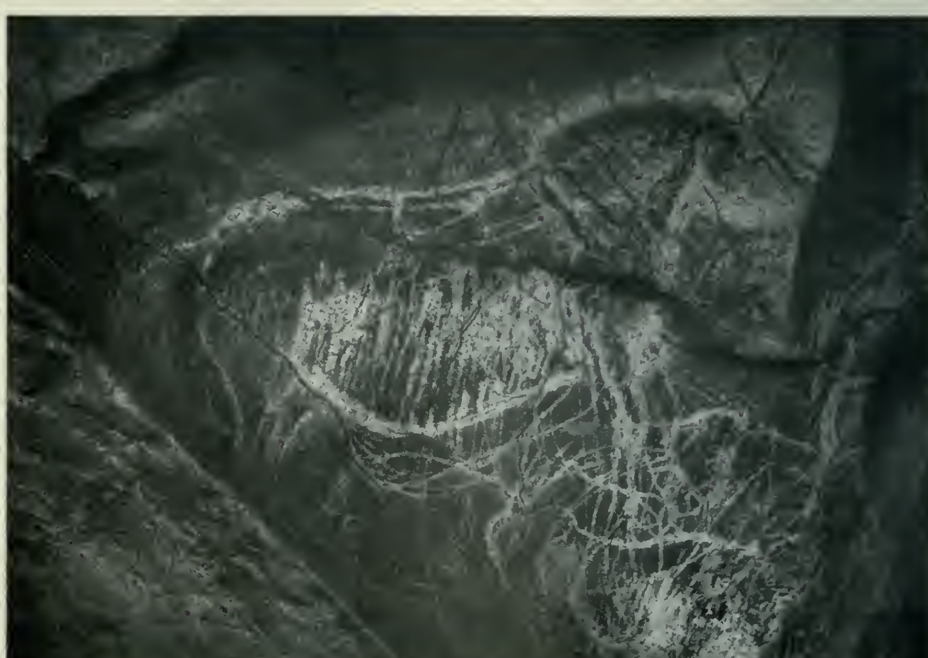
taken place here. The heel prints are limited in number and may well have been made while the sculptors were gathering clay for the bison models. In fact, there is no evidence that this chamber was devoted to any purpose other than the execution of these bison sculptures and it may never have been visited again. This is the ever recurring mystery of Palæolithic purpose. The subject of the two bison, male and female, relates to the reproductive instinct and not directly to the chase as in the case of the bison drawn in the not far distant cavern of Niaux with arrows indicated on their sides. As we return from the Salle des Bisons and descend along the *galerie supérieure* there are evidences of occupation, not only by the cave bear but by cave man, who has left little heaps of scattered implements and bones showing that several parts of the cave had been inhabited for short periods during the winter season—perhaps when the constant internal temperature of $12\frac{1}{2}$°C. ($54\frac{1}{2}$°F.) rendered the interior far more habitable than the country without, subject as that was to the severe climate of the Pyrenees in the Ice Age.

DISCOVERY OF THE CAVERNE DES TROIS FRÈRES

At the top of the same little limestone mountain containing the cavern of Tuc d'Audoubert is an opening long known to the shepherds of the region as the 'Point Souffleur' from which the relatively warm air currents of the cavern issue in winter and melt the snow, while relatively cool breezes issue in summer. On July 20, 1914, the Bégouen brothers suddenly decided to descend this rock chimney and see where it led. They were let down by a long rope and upon reaching the bottom found themselves in an entirely new cavern, which has since received the name of Les Trois Frères in honor of its discoverers. Even the preliminary survey made by these youths revealed that —though not far distant from the cavern of the Tuc d'Audoubert—it represented an entirely different art period and a cavern technique of another order; that its walls were fairly covered with designs; and that the relatively few flint-incised outlines were executed in an entirely different style. Every available surface of the Trois Frères, whether ceiling or

Entrance to the grotto of Enlène on the side of the mountain of Tuc d'Audoubert, discovered many years ago, where Magdalenian industrial deposits were found from which was obtained the well-known Enlène *propulseur* (dart-thrower), carved in reindeer horn

Entrance of the stream Volp in the side of the limestone mountain of Tuc d'Audoubert, which —traversing the mountain—may be identical with that which issues from the entrance of the cavern of Tuc d'Audoubert shown on p. 32. Photograph by permission of the Comte de Bégouen



Etched figure of reindeer (upper) and of Celtic horse (lower) in the cavern of Les Trois Frères. From photographs reproduced by permission of the Comte de Bégouen sides, has a design upon it, and it has required two seasons of very hard work on the part of the eminent historian of prehistoric art in France, the Abbé Henri Breuil, to reproduce these etchings. We had the pleasure of meeting the Abbé Breuil at the Château des Espas, the residence of the Comte de Bégouen, and learned from him that there was still several months' work to be done. The walls which the prehistoric artists faced were uniformly covered with a brown coating quite unlike that of the limestone of other caves. They solved the difficulty by scratching off this coating to produce a strong, *white* contour line instead of the black which outlines the animals pictured in the Niaux cavern, or the deep, flint-incised outlines seen in the adjacent cavern of Tuc d'Audoubert.

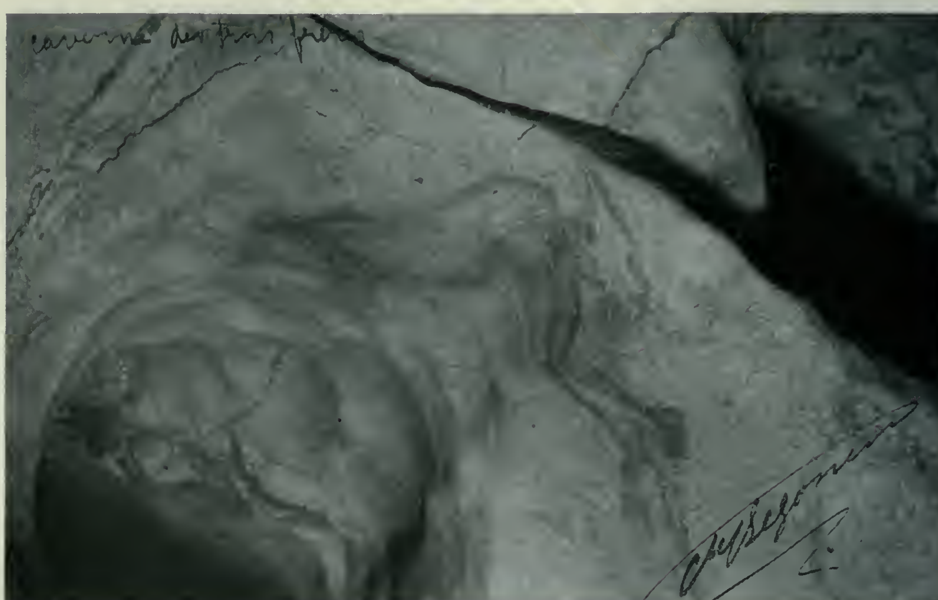
This is well shown in the reindeer and the small Celtic horse reproduced herewith. The photographs do not reproduce with sufficient clearness the effect of these etchings, so the whites and blacks have been slightly intensified to convey to the eye the effect actually given when such etchings are surveyed with a powerful acetylene light. So perfectly portrayed are the exact proportions and characteristics of these two animals, that, even if they be critically examined by a zoölogist, there is no mistaking either the genus or the species to which they belong. The distinguishing points in the Celtic horse are the small head and the high, arched neck and white mane of the stallion. In the reindeer the broad contour lines beneath the head and the body, which are part of the scheme of protective coloration or concealment, are indicated by removing the brown surface from a considerable area, leaving only a patch of brown here and there to indicate the limbs and shading. In the case of the pony the white coloring extends beneath the jaw and the belly line. Thus not only the contour but also the coloring of these two animals is very clearly and characteristically indicated. The entire silhouette of the upper part of the body is absolutely accurate and true to life.

This unique style and greater freedom in drawing distinguish the work found in the Caverne des Trois Frères, which presents all the characteristic mammalian life of the period, namely, the horse (of different species) and the reindeer (a single species)—both favorite subjects—the mammoth (less frequently portrayed), the bear, the lion, the panther, the stag, and—most numerous because most coveted for food—the bison. All these animals and others more recently discovered—which, for the present, we are not at liberty to mention—are portrayed with the same fidelity by these Palæolithic artists. Thus we have a complete portrayal of the mammalian life of the Pyrenees in this early period of Magdalenian art, probably antecedent to the period of mural painting.

In speaking above of the discovery of the Caverne des Trois Frères we did not recite the fact that for a second time the Comte de Bégouen hurried to the spot, ran all the risks, and verified this fresh discovery by his three sons. The cavern is still very difficult of access—"*très pénible*" in the words of the Count. It is necessary to crawl, to stoop, to pass certain points on one's back or sideways, yet it has been visited frequently by the Count and by the late dean of French archæologists, Emile Cartailhac. We were also conducted by Mlles. Denise and Lisette de Lalanne, the daughters of Dr. Gaston de Lalanne, of Bordeaux, a well-known French archæologist and eminent also as a physician. Both of them had donned brown miner's suits for the occasion.

Again the *élan* of the 'cavernist' carried us through all difficulties into the final chamber, where on the ceiling we perceived in faint relief the painted figure of the Sorcerer. We were at last in the Salle du Sorcier, where, surrounded by numerous etchings, this strange medicine man presides. To the painstaking and minute observation of the Abbé Breuil we are indebted for the elucidation of all the details presented in the accompanying drawing. The interest of this figure of the *Sorcier* is enhanced by the fact that it is not a unique representation. Though far more perfect and of larger size, it strikingly resembles the engraving of a sorcerer found many years ago in the now miraculous grotto of Lourdes. Each figure is terminated with a fox's tail and is same manner as the animals are etched in other parts of this wonderful cavern. The figure is represented partly stooping in a gesture which the Count well describes as "*le geste de faire le beau*," an attitude which is also observed in some of the drawn figures in the grotto of Combarelles. Following his description of this strange figure, the Comte de Bégouen writes:

Ce mélange de caractéristiques nous fait écarter également l'idée d'une mascarade rituelle



Painting and engraving of the Sorcerer as it appears on the roof of the Salle du Sorcier in the cavern of Les Trois Frères when illuminated by a strong acetylene light. Photograph by permission of the Comte de Bégouen

surmounted with the horns of a stag, and from each face hangs the long, pointed beard. The Trois Frères figure is superior in showing the mask and ears of a fox and the apparent insertion of the arms of the sorcerer in the pelage of the forearm of a bear or some other carnivore—that is, the hands are masked like the face, while the feet, the trunk, and the thighs are either covered with fur or, more probably, painted in stripes. The remainder of the body is etched on the brown-coated rock very much in the

spéciale. Catlin, à qui il faut toujours revenir, nous décrit des danses de l'ours ou du bison dans lesquelles le ou les participants revêtent les têtes de l'animal qu'il convient d'honorer et de rendre favorable ou au contraire de détruire. Si donc l'imagination s'est donné libre carrière dans la confection en quelque sorte synthétique de l'accoutrement, c'est qu'il s'agit de représenter soit un esprit supérieur ayant par conséquent les attributs des différents animaux qu'il domine, soit l'homme capable par son pouvoir magique d'en être également maître. Nous avons des quantités d'exemples de l'un et de l'autre cas chez tous les peuples primitifs, des Esquimaux aux Australiens en passant par les indigènes de l'Afrique ou de l'Amérique, les Sounis en particulier.

Dans le premier cas, il s'agirait de la représentation d'une sorte de divinité, dans le second, de celle d'un sorcier. C'est vers la seconde hypothèse que nous penchons. Nous croyons que l'artiste quaternaire a voulu représenter un magicien. Dans quel but, nous l'ignorons. Rien ne nous permet de deviner la mentalité qui était la sienne ni la préoccupation à laquelle il a obéi.

Il semble que cet artiste, c'était le sorcier lui-même, qui aurait tracé avec minutie et fidélité son propre portrait revêtu de ses attributs rituels. Il l'a placé dans le recoin le plus reculé de la caverne inférieure, mais sur une paroi dominant ces centaines de figurations d'animaux que lui ou ses confrères ont, pendant de longues suites de générations, tracées pour des envoûtements. Car tout dans cette caverne nous parle de magie.

None of these drawings are removable. The figure of the sorcerer itself is not very conspicuous and to make out all its characteristics has required the most microscopic study on the part of the Abbé Breuil. It was necessary to visit this cavern personally in company with one of the archæologic experts of France, to appreciate the full meaning of this art and to discover the inconspicuous but most significant pictures. There is little doubt that this entire mural art is connected with the spirit of the chase.

(Left) Engraving of a sorcerer found on a piece of schist rock in the grotto of Lourdes, now preserved in the Musée de Saint Germain, reduced to about half the actual size

(Right) Engraving and painting of the Sorcerer on the roof of the Salle du Sorcier in the cavern of Les Trois Frères, as interpreted by the Abbé Henri Breuil, one-fifteenth actual size

THE SCULPTURES OF LAUSSEL

In the more northern art center around the valley of the Vézère is the grotto of Laussel, where Dr. Gaston de Lalanne has been working for many years and has been rewarded by the discovery of the most remarkable series of prehistoric sculptures of the human figure which have been found in France. The site is shown in the photograph on the page following. The figure which Dr. Lalanne in his capacity of student of prehistoric remains calls "*la bonne femme de Laussel*" was found at the point indicated by a white cross on the projecting point of rock beneath the shadow of this grotto, which Dr. Lalanne regards as possibly an ancient sanctuary. *La bonne femme* has the robust proportions of all the feminine statues of the period and, like the others, is the work of a race which held that

The rock shelter of Laussel, supposed to be an ancient sanctuary, which contained four Palæolithic bas-reliefs in stone, including those known as "*le chasseur*" and "*la bonne femme de Laussel.*" The latter was on the stone indicated by a white cross. Reproduced by permission of Dr. Gaston de Lalanne

maternity is the chief end of womanhood. There is no effort at the expression of either beauty or proportion of figure, and the rough, brown sandstone does not admit of anything in the nature of delicate sculpture of the face and head —a part of the human body far too difficult for the sculptors in this remote Aurignacian period of the development of their art. A second figure of a woman is inferior in design to *la bonne femme.* A third feminine figure is more or less symbolic of the act of parturition.

None of the feminine figures betrays any attempt on the part of the artist at the expression of the beauty of the human form, and we might infer that the Crô-Magnon artists of this time—so keen to portray the beauty of the animal form—were indifferent to it in mankind, were it not for the companion statue of *le chasseur*, which Dr. Lalanne found within a few feet of *la bonne femme.* We had the privilege of examining all these statues in a powerful light in Dr. Lalanne's studio in Bordeaux, and were deeply impressed, not only by the and also of the cup-bearers from the palace of Cnossus, Crete. The body faces slightly toward the front, and one may perceive the line where the thorax joins the abdomen—that is, the lower line of the ribs, above the slender abdominal line of the typical hunter. More re-

(Left) *La bonne femme de Laussel*, bas-relief of a woman with a drinking horn, found within the rock shelter of Laussel and described by Dr. Gaston de Lalanne in 1912, belonging to the late Aurignacian age. One sixth actual size

(Right) *Le chasseur de Laussel*, bas-relief of a spear-thrower or archer, sculptured on the face of a boulder found within the shelter of Laussel and described by Dr. Gaston de Lalanne in 1912, also of late Aurignacian age. About one sixth actual size

real beauty of the masculine figure of the hunter, but by the evidence it gave of surprisingly close observation of anatomical detail. The pose is extremely fine and the figure may be conceived as in the act of either throwing a spear or drawing a bow. The broad shoulders and slender, girdled waist remind us strongly of figures of Apache hunters, markable, at the top of the shoulder one can perceive the swelling of the deltoid muscle and the point where it subsides into the brachialis as in the modern athlete. The head is turned to the left, indicating that the face was looking in the direction of the spear or of the arrow, but there are no indications of the features—in fact, it would have been impossible in this coarse sandstone and with the tools then available to model the human features.

Dr. Lalanne has a superb collection of Aurignacian flints, including hammer stones and chisel-like implements with which the sculptor may have worked. His atelier is crowded with a series of implements which give us all phases of the grand Aurignacian flint industry. Near the *bonne femme* was found an assemblage of the finest types of flints —possibly an accidental association, though Dr. Lalanne considers that the sculptors probably employed a variety of implements in roughing out and preparing the ambitious statuary of his priceless collection. Of the same age are a number of very large implements—hammer stones, planing stones, and *pics* —which were well adapted to this massive work and to such undertakings as the subsequent Magdalenian horse sculpture of Cap Blanc. To the prehistoric archæologist the age of these statues is the matter of commanding interest. It is determined by the excavations of Dr. Lalanne as *Aurignacien supérieur* beyond the possibility of doubt.

We may point to the industrial parallels which he finds between the grotto of Laussel and other famous and typical sites as indicated in the table below.

We are not inclined to accept the theory of Dr. Lalanne that the Laussel sculptures represent the negro-like Grimaldi Race, which, our readers will recall, is the only Palæolithic race with the negroid type of face thus far discovered, and is represented by two skeletons found in the Grottes de Grimaldi on the Mediterranean near Mentone. Thus far no evidence of the practice of burial has been found in any of these excavations at Laussel. It is true that in the search for burial places Dr. Lalanne came upon the famous series of sculptured horses at Cap Blanc, which are regarded as belonging to the art of early Magdalenian times, and therefore as somewhat more recent than the human sculptures of

Font Robert	AURIGNACIEN SUPÉRIEUR of Laussel. Here we find the five large sculptured figures—*la bonne femme* and *le chasseur* among them—as well as narrow, flint spear-heads worked on both sides with a shallow notch at the base of either edge for attachment to a shaft.	CRÔ-MAGNON RACE
Crô-Magnon Grotto Containing the type of the Crô-Magnon Race Gorge d'Enfer Aurignac Grotto	AURIGNACIEN MOYEN A superb flake industry, with beautiful *racloirs* and *bifaces*.	
L'Abri Audi *Lissoirs* and *pointes de Châtelperron*	AURIGNACIEN INFÉRIEUR Typical Aurignacian industry.	
La Quina Latest period of the Neanderthal Race	MOUSTÉRIEN SUPÉRIEUR (Last of Neanderthal Race.) Close of the Mousterian industry	NEANDERTHAL RACE
Chez-Pourré near Brive	MOUSTÉRIEN MOYEN Typical Mousterian industry (a period of long duration)	
Combe Capelle The industry includes a few *coups de poing*	MOUSTÉRIEN INFÉRIEUR Numerous *bifaces* and remains of reindeer.	
La Micoque	ACHEULÉEN SUPÉRIEUR *Bifaces* predominant. No trace of reindeer.	

Laussel. Our principal ground for dissenting from the theory that the Grimaldi Race was portrayed in the Laussel sculptures is that repeatedly expressed in *Men of the Old Stone Age*, namely, that all this art, both mural and sculptural, is the work of a single racial mind and racial spirit. New types of implements may have come in by invasion, but in the orderly development of a single art—an art marked by the combined love of beauty and truth—we have the most positive proofs of the craftsmanship of a single race.

Life-size horse at Cap Blanc, sculptured in high relief, of early Magdalenian age, now one of the national monuments of France. After Lalanne in *l'Anthropologie*, 1911

SOME FEATURES OF MUSEUM PROGRESS DURING THE PAST FIFTY YEARS

BY

FREDERIC A. LUCAS*

THE past half century has witnessed great progress in museums, not only in the growth of their collections, the increase of their scientific work, and the publication of results achieved; but in methods of preparation, in the manner of installing exhibits, and in the utilization of these exhibits with their accompanying labels, together with lectures and handbooks, for the purpose of illustrating ideas and placing information before the public: and in all of these phases of improvement the American Museum of Natural History has played a leading rôle.

No one individual can claim the credit for this progress, nor is it due to any one favorable circumstance; many men and many events have helped, but the great factor has been not merely the ability but the readiness to take advantage of opportunities, for when opportunity knocks at the door, the householder must be ready to open, otherwise the visitor may go elsewhere.

It is this willingness or eagerness to grasp new ideas, to take advantage of inventions and improvements in methods, that distinguishes the progressive from the unprogressive museum or, for that matter, any enterprising institution from its laggard fellow.

It may be said—and truthfully—that the American Museum of Natural History owes much to the generous support it has received from its trustees, but this support would not have been given had it not been thought warranted by the Museum's progress, especially as evidenced by the educational work accomplished through its many and varied activities.

Fifty years ago, when the American Museum of Natural History came into being, the aim of a museum—so far as its exhibits were concerned—was to show the public a series of named objects upon which visitors were permitted to gaze, but not encouraged to do so, the privilege being frequently restricted to certain hours on stated days. To illustrate ideas or to show the use of these objects—or their habits if they chanced to be animals—was, we will not say not thought of, but certainly not done, and it was not even deemed necessary to show them to the best advantage.

There were then but three museums of prominence in the country, and all of these were in the earlier stages of their existence. The United States National Museum was housed in the Smithsonian Building; the Museum of Comparative Zoölogy was small and struggling, and the Philadelphia Academy of Sciences was not large. None of them looked upon exhibition as a prime function, and such institutions as the Peabody Museum at Salem and that of the Buffalo Society of Natural Science were conducted on much the same lines. A museum was not an institution by itself so much as an adjunct to some scientific society.

The change in the attitude of museums toward the public is due not merely to change in ideas, but in the ability to carry ideas into effect, and this ability is in turn largely due to improvement in methods and materials by the use of which it has been possible to arouse the interest of the public; if you cannot interest visitors, you cannot instruct them. The success or failure of a museum depends, in popular parlance, upon its ability to "put over" the message it wishes to convey.

Now the educational work of a museum is more dependent on its mechanical work than one might suppose, and progress in the one reflects, or is largely

*Director of the American Museum

due to, improvements in methods of the other. Heads and hands are sometimes more interdependent than the heads are willing to admit. Thus our knowledge of the life of the past, of the structure and habits of such creatures as dinosaurs, with no near living relatives, is directly due to improved methods of collecting, preparing, and mounting. It makes a great difference, particularly with large animals, whether they are studied in whole or in parts and many features are not realized until the entire skeleton is seen. The American Museum of Natural History may justly claim to have brought these branches of museum work to a high stage of perfection.

Many improvements in methods have a place in the history of the various departments of the Museum with the progress of which they are intimately related, notably so in the case of the departments of birds and of fossil vertebrates, and one phase has been dwelt on at some length in the *Guide Leaflet* "The Story of Museum Groups."[1] As there recorded, the group of today is the result of a combination of improvements in many branches of work but, more than this, it is the result of inventions and improvement in lines in which the Museum is not directly concerned, but of which it has taken advantage, and without which results such as are now obtained would not be possible. For example, so long as the only foliage available was composed of the crude, cloth leaves made by dealers in millinery supplies, it was not possible to copy nature with any degree of realism. Then came the Mintorns with their method, later superseded by that of Akeley, and "habitat groups" began to spring up in the land.[2]

[1]"The Story of Museum Groups." *Guide Leaflet Series*, No. 53. By Frederic A. Lucas.

[2]It is quite possible that the modern preparator with his varied materials ready at hand and mechanical devices ever at his command does not appreciate the difficulties under which his predecessors labored, nor give them due credit for what they accomplished. What would the modern man do without gas and electricity and his steam-heated workrooms? What would he think if he could not get such simple materials as cotton batting and wire cloth, if he had to grind his own colors, refine his own beeswax and use hand-wrought nails? Would he not throw up his hands in despair?

Probably no one invention has been of more importance to museums than that of electric lighting, for without it our beautiful habitat groups would have been practically impossible. The difficulty of employing gas with its heat and fumes, the impossibility of using so inconstant and uncertain a light as daylight would have limited the exhibiting of habitat groups to certain times of the day and even of the year. But this is only one incident, so to speak, for before electric lighting became universal, museums were poorly lighted, if lighted at all, and there are those who think the day is not far distant when, so far as exhibition is considered, daylight will be discarded and halls illumined by electric light only.

It is not claimed that the American Museum has led in *everything*, that it has invented all the methods and devices now in general use, but many of them have originated within its walls and it has been ever ready to avail itself of others.

In the matter of animal groups, the American Museum of Natural History was anticipated by the United States National Museum and the British Museum, but in the shape of habitat groups,[1] the American Museum carried them to a much higher degree of perfection, and if some of the largest and finest groups of mammals are now to be found in other institutions, it is to be remembered that these museums have profited by the costly experiences and experiments of the American Museum of Natural History, and that they were planned and executed by preparators who had gained their knowledge in this institution. And

[1]As "habitat group" has come to have a rather definite meaning in museum circles, it may be well to give here a definition taken from Doctor Chapman's introductory remarks in the *Leaflet*, "The Habitat Groups of North American Birds." "These groups of birds are designed to illustrate not only the habits but also the haunts or 'habitats' of the species shown. Each group usually includes the nest, eggs and young, besides the adult bird or birds, with a reproduction of from 60 to 160 square feet of the nest's immediate surroundings. To this accurate and realistic representation of the home of the species is added a painting from nature of its habitat, the real foreground being connected with the painted background in such a manner that one often does not at first see where the former ends and the latter begins. The whole, therefore, gives an adequate conception of the nature of the country the birds inhabit and the conditions under which they live."

if the genius of Akeley devised the methods that did more than anything else to make taxidermy an art while he was at the Field Museum, yet his last and one of his most important processes was thought out and put into practice at the American Museum of Natural History.

Glass models of invertebrates were made by the Blaschkas—father and son—in the seventies, but although the use of glass in the American Museum of Natural History was begun only in 1907, yet in the skilful hands of Mr. Herman Mueller, under the direction of Mr. Roy W. Miner, have been wrought during the past decade marvels of glass that make the work of the Blaschkas seem crude. Here is one of the instances where mechanical skill far outweighs scientific knowledge: a student may thoroughly understand the structure of a radiolarian, may be able to make an accurate drawing of it, but to transmute the drawing into fragile glass and make it understandable to everyone is quite another matter.

The American Museum of Natural History cannot claim the credit of having introduced what may be called the explanatory label, for this, we think, was done—or first done—on an extensive scale by Doctor Goode at the United States National Museum, but the American Museum was not long in adopting what I believe to be still the most effective mode of imparting information to the public at large.

Much time and thought have been given to the problem of devising labels that shall be not only instructive but shall so present the information contained that it will be interesting. With the aid of a dictionary or a textbook, almost anyone can write a technical label. It matters not how much information is contained in a label if it be not read; getting it read is the great problem and here much depends on the manner in which the accompanying object is shown.

In the matter of publications couched in untechnical language, which in a way are extended or amplified labels, the American Museum of Natural History has improved its opportunities. The credit of introducing guide leaflets belongs, however, abroad, for they were issued by the British Museum, and what is probably the best series of handbooks or leaflets, as regards the interesting manner in which the subjects are presented, is that issued by the Horniman Museum. This is said without any reflection on any institution—it is not given to every writer to set forth his subject in an interesting way, any more than every student can hope to be a Huxley or a Darwin.

The *Leaflets* of the American Museum were an offshoot of the AMERICAN MUSEUM JOURNAL, commenced in 1901 as a means of keeping members informed of the work of the Museum: the first was a "supplement," reprints being issued as *Guide Leaflet* No. 1.

In 1907, the *Leaflets* were issued independently of the JOURNAL and in 1912 the series of *Handbooks* was begun, dealing with subjects illustrated by the collections rather than with the objects themselves.

Fifty years ago illustrated lectures were just beginning to be common, "magic lanterns" for "dissolving views" were installed in but few institutions, and colored lantern slides were something to be wondered at. Today every school and even many classrooms have a projection apparatus; the audience almost feels insulted if shown a plain photograph and expects a reel or two of motion pictures.

Professor Bickmore and the American Museum of Natural History were pioneers in this line of museum work; the colored lantern slides of flowers prepared for him have never been excelled, and the state has borrowed from the museum the idea of illustrated lectures for the schools.

Thus we have progressed from the regular rows of animals most literally stuffed to the habitat group portraying amid their natural surroundings animals, each of which is as carefully and accurately modeled as a statue or, if small, cunningly wrought from glass or wax that exactly reproduces nature; from the label bearing only a name and a locality to the explanatory label and through this to the leaflet and the handbook; from an occasional lecture to series of carefully planned lectures in which nature is shown in her true colors and her subjects portrayed in action, and delivered not only in the Museum but in distant lecture centers.

It is not what a museum *has* that counts, but what it *does;* the servant who buried his talent in a napkin brought no return to his master; the museum that keeps its treasures to itself makes no return to the public or to science. The American Museum of Natural History has ever lived up to its motto, "For the people, for education, for science," keeping the people and their education uppermost, yet, in doing this, not being unmindful of the demands of science. It has always given freely to other institutions its ideas, its information, and its methods, so that progress has not been confined to itself but has been general. Whereas fifty years ago museums could be counted on one's fingers and were looked upon as being for the benefit of a favored few, today they are spread throughout the length and breadth of the land, are recognized as being for the people, and are regarded as among the most efficient instruments of both popular and advanced education.

THE STRUGGLE FOR EXISTENCE AT THE MARGIN OF A TIDE POOL

The crevices of the rock overhanging the pool and forming its sides are crowded with black mussels (*Mytilus edulis*) of small size. These are being invaded by hosts of gaily colored "purple" sea snails (*Thais lapillus*) which bore minute holes in the shells of the mussels and devour them

BIOLOGICAL WORK ON MOUNT DESERT ISLAND

BY

ROY WALDO MINER*

"STUDY Nature, not books," the motto of the great Louis Agassiz, shows prominently above the lecture platform in the Marine Biological Laboratory at Woods Hole, Massachusetts. This is the aim of the chain of seaside laboratories which have gradually been established along the coast during the last half century for the study of marine life in its natural environment. The importance of the work of these institutions cannot be overestimated. Through them, biologists from most of the colleges and universities of the United States and Canada turn annually to the sea, the original abode of animal life, and penetrate its watery veil in search of the secrets of the abundant life hidden beneath, secrets the knowledge of which is fundamental to the study of living organisms, including man himself. The Marine Biological Stations of the United States and Canada now include those at Woods Hole, Massachusetts; Cold Spring Harbor, Long Island; Mount Desert, Maine; St. Andrews, New Brunswick; Beaufort, North Carolina; Miami and Tortugas, Florida; La Jolla and Pacific Grove, California; and Friday Harbor in Puget Sound,—thus affording an opportunity for the study of marine life in a great variety of environment.

Some of these, like the Marine Biological Laboratory at Woods Hole, are large institutions, with hundreds of students and investigators utilizing their facilities annually. Others counteract their smaller size by the earnestness and intensity with which they pursue their work. Noteworthy among these is the Harpswell Laboratory, which has recently established its Weir Mitchell Station at Salisbury Cove on the sheltered northern shore of Mount Desert Island, Maine, about six miles from Bar Harbor. Founded in 1898 by Prof. J. S. Kingsley, then head of the biological department at Tufts College, the laboratory made its headquarters for nearly a quarter of a century at South Harpswell, on Casco Bay, where it attained an enviable record for research work, especially on marine life.

As stated in its prospectus for 1921, it became in the past year a member of The Wild Gardens of Acadia Corporation, of Mount Desert Island, where a tract of fifteen acres was offered it for the establishment of a new station. Here the conditions for the work and future development of the laboratory are so favorable that a period of rapid progress and greatly increased scientific usefulness is assured, under the able management of its director, Prof. Ulric Dahlgren, of Princeton University. The first season in the new quarters has been very successful, and the prospects for the second summer's work are correspondingly good.

Salisbury Cove is a picturesque little fishing and agricultural village, a relic of a bygone time. Years ago it was famous as a ship-building community, and in the days of sailing vessels many a fine ship could be seen in foreign ports with "Salisbury Cove, Maine" painted upon its stern. In these modern days of steam navigation the village has been outstripped and forgotten, while neighboring communities, through various adventitious causes, have attracted the builders of summer houses by the sea. These places have developed into fashionable summer resorts and have linked their names firmly with Mount Desert Island in the public mind, Salisbury Cove meanwhile remaining quietly in the background. Nevertheless, its ex-

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The sand beach viewed from its eastern end. Beneath the bowlders in the foreground congregate numerous nudibranch mollusks and flatworms. A powerful surf breaks on the sandy stretch beyond

cellent harbor, formed by that arm of Frenchman's Bay known as Eastern Bay, is still a safe anchorage for vessels, while its very isolation has preserved a naturally beautiful environment.

From the biologist's standpoint, its situation is exceptional. The sheltered coast line on this side of the island is indented by a succession of coves, floored with sandy mud, and backed by a rocky rampart of cliffs, which jut out at intervals as picturesque headlands covered with spruce growth. The tide rises and falls a distance of twelve feet, so that a considerable stretch of mud flat is laid bare at low tide, where marine worms, clams, crabs, and gastropods abound. The waters of Eastern Bay afford good dredging, and the wharf-piles of the extensive United States coaling station on the shore of the opposite mainland are crowded with marine algæ, ascidians, sea anemones, and sea stars. The deeper waters of Frenchman's Bay are alive with various marine fishes and Crustacea, including lobsters.

South of Bar Harbor there is an excellent sand beach a quarter mile in length, facing the south and the open sea, and protected by the rocky promontories of Great Head and Otter Cliffs. At the eastern end, the low tide exposes a stretch of bowlders rounded by wave action, beneath which numerous nudibranch mollusks (*Onchidoris bilamellata*) and large turbellarian flatworms may be found in quantities. At the western end fragments of rock broken from the cliffs are encrusted with small, edible mussels upon which feed hordes of the gaily colored "purple" sea snail (*Thais lapillus*). Here, on the sand beach, frequent, rounded mounds betray the presence of the burrowing sand-collar snail (*Natica heros*), which at high tide creeps out to hunt razor-shells and clams, its favorite prey. Above the beach rise several forest-covered hills of granite, the most prominent of which, the Beehive, accurately described by its name, is 540 feet in height and affords an excellent view of this part of the coast.

On the eastern shore a large cavern, known as Anemone Cave, has been hollowed out by the waves. On the cave floor, under the shelter of the overhanging roof, many tide pools with quiet, transparent waters are disclosed at low tide. These are the abode of green, red, and brown sea anemones (*Tealia

Forest-covered hills of granite hem in the beach at either end, the dome-shaped "Beehive" rising in the background. This is a foothill of the picturesque range within which the Lafayette National Park is located

crassicornis and *Metridium marginatum*) and the rocky bottoms are completely covered with pink coralline and varicolored encrusting algæ and Bryozoa, while gray-green sponges adorn the sides and fill the crevices. Here and there, amid this profusion, show the orange-yellow slits made by the gaping shells of horse mussels (*Modiola modiola*), the valves of which are so covered by the various marine growths that, when the shells are closed, their presence cannot be detected by the observer.

There are also excellent tide pools near the southern extremity of the island at Ship Harbor and at the Sea Wall. The latter is a natural wall or embankment consisting entirely of small, sea-rounded bowlders, which have been cast up during the winter storms to form a rampart several hundred feet in length and a dozen or more in height. A road crosses this rampart obliquely, but is obliterated by the storms each winter and the following year has to be reconstructed. Below the Wall the shore is of shelving metamorphic rock fractured here and there into quadrangular blocks. Many of these have been torn out by wave action, leaving extensive, rectangular hollows of a peculiarly artificial appearance. These remain flooded at low tide and are occupied by hosts of plants and animals. Pelagic forms—jellyfishes, siphonophores, ctenophores, and salps—swarm in the deeper waters off shore or are blown in upon the coast and stranded.

The oceanic shelf recedes rapidly to depths of one hundred fathoms, where there is an excellent opportunity to secure deep-water forms. The laboratory hopes soon to possess a sea-going boat equipped with the proper facilities to dredge for bottom-living species, and especially for the luminiferous organisms obtainable at such depths, to our knowledge of which Professor Dahlgren has contributed so extensively.

Not only is Mount Desert Island of great interest to the marine biologist, but it presents unusually interesting problems also to the student of fresh-water life, the entomologist, the botanist, and the geologist. To appreciate the significance of this statement, it is necessary to understand the peculiar topography and general geological features of the island. Mount Desert, with an area of one hundred square miles, is the largest rocky island on the coast

Anemone Cave on the eastern shore of Mt. Desert Island. On the cave floor many rock pools are visible at low tide, where sea anemones are abundant; pink corallines, varicolored algæ, and Bryozoa encrust the pool bottoms

Shore near the Harpswell Laboratory, Salisbury Cove, at receding tide. Near by are mud flats where clams, marine worms, and crabs abound. The tide falls a vertical distance of twelve feet

The Sea Wall near the southern extremity of Mt. Desert Island is a natural rampart extending for a distance of several hundred feet along the shore, and consists of rounded bowlders cast up by the storm waves

Below the Sea Wall the shore is of shelving rock, which has been fractured by wave action, so that basins with perpendicular walls are excavated, which the sea transforms into tide pools of unusually transparent waters

A SPONGE-LINED POOL

These water-filled rock basins left stranded by the receding tide are focal areas in which the life of the inter-tidal zone mingles with that which is always submerged, resulting in a luxuriant concentration of living forms

A TIDE POOL AT THE SEA WALL

The rectangular walls of these pools give them an almost artificial appearance. The water is so transparent that the margin can hardly be detected in the above photograph. Many sea anemones with extended crown of tentacles can be seen on the pool's bottom

The burrows of the sand-collar snail, *Natica*, may be detected by small, rounded hummocks visible in the sand at low tide. One of the snails, withdrawn into its shell, is seen in the foreground

of New England. Originally a part of the mainland, the shore of which here runs nearly east and west, it is traversed by an interrupted mountainous ridge of granite that before the Ice Age was a continuous wall lying parallel to the coast. During the last glacial invasion, the ice sheet descended upon the island, cutting it off from the mainland and hewing great cross-chasms in the mountain wall, which was thus separated into fragmentary masses, alternating with narrow, peculiarly parallel, north and south valleys. The result is a succession of mountain peaks ranged in an east and west line through the middle of the island. Beautiful lakes, long and narrow in outline, now occupy the valley bottoms; one is 1100 feet above sea level. The mountains rise to various heights, culminating in Green Mountain at 1527 feet. The most central of the long, narrow valleys opens out to the sea, which has completely flooded it, creating a fjord known as Somes Sound. The mountain slopes are forest-covered, but with bare, granite-capped peaks, and afford magnificent views of mountains, lakes, forests, island-broken sea coast, and the open ocean, over which the eye ranges a distance of sixty miles. Through the efforts of public-spirited residents of Bar Harbor and its vicinity, this forested mountain region, so exceptionally located, has been set apart as a wild life sanctuary belonging to the nation, under the name of the Lafayette National Park. The biological investigator and geologist will find this reservation a splendid field for environmental study. It is open to all who love to wander in regions of forest wildness and scenic beauty. The numerous streams and brooks contain trout and an abundance of invertebrate life, including microscopic fresh-water organisms. Entomologists have already found here many insects peculiar in type because of their isolation. Botanists have discovered northern and southern plant forms growing side by side, and such

The initial laboratory building now housing the Weir Mitchell Station of the Harpswell Laboratory, though as yet comparatively small, has accommodations for ten research workers. It is now being provided with pumping apparatus and lighting facilities, and is the nucleus for the projected equipment, which, it is expected, will be fully adequate for carrying on most effective biological instruction and research in northern waters

anomalies in habitat occur as the strictly alpine plant, *Empetrum*, in situations just above the high-tide limit.

In surroundings of such unusual biological interest, the prospects for the development of the newly established station of the Harpswell Laboratory are most propitious. The American Museum has periodically enjoyed the advantages of coöperation with this laboratory in its former location and with the Marine Biological Laboratory at Woods Hole, Massachusetts. During the past season the work of the department of lower invertebrates was greatly facilitated by these two institutions. Marine field work is essential for three reasons: (1) to obtain original material for research, (2) to secure specimens for exhibition and for the study collections, and (3) to make the sketches, photographs, and observations that are required for the groups and models that form the basis of a large proportion of the exhibits in the Darwin Hall. The new station affords a unique opportunity for the extension of this field work along the rocky northern Maine coast, in a region of high tides; on the other hand, the Woods Hole Laboratory is a convenient center for the study of the forms peculiar to a low-lying sand and mud habitat in an environment of comparatively low tides.

Through the courteous coöperation of these institutions and others in the tropics and on the Pacific coast, the Museum hopes greatly to extend its marine coastal work in the immediate future.

SHACKLETON

BY

ROBERT CUSHMAN MURPHY*

SIR ERNEST SHACKLETON was one of the most popular of explorers. If conceivable, he was even more of a favorite in the United States than in his own country. His idealism, wit, modesty, courage, and staunch loyalty both to his work and to his fellow-men, always held public good will, even though adversity might disrupt the most carefully laid of his polar plans. His was the rare type of personality which compelled mankind to judge his misfortunes only with sympathy. He could fall short of his objective and yet lose neither esteem nor trust.

Shackleton was born at Kilkee, in the south of Ireland, in 1874, the eldest son of a physician. His education at Dulwich College, London, was never completed, because of an irresistible bent for the sea. Before he took part in the transportation of troops during the Boer War, he had sailed four times around the world.

In 1901 he was appointed third lieutenant of the National Antarctic Expedition under command of Robert Falcon Scott, who subsequently testified that, in addition to more rugged virtues, Shackleton's unvarying cheerfulness was a great asset during the whole voyage. In November, 1902, Shackleton accompanied Scott and Dr. Wilson on the first great south polar land journey. For fifty-nine days the three men, with dog sledges, traveled southward across the lifeless continent, where all conditions were totally unknown and unexpectedly severe, reaching 82° 17′ of south latitude before they were obliged to turn back.

Five years later Shackleton organized, largely at his own expense, the British Antarctic Expedition, which proved to be the greatest of his material achievements. On New Year's Day, 1908, he sailed from New Zealand in the small whaler "Nimrod," and proceeded directly to Ross Sea. Among the innovations used on this expedition were eight Manchurian ponies, of which four lived to do good service. The scientific results of the field work were of first importance, the explorers making many excursions and surveys, and discovering an Antarctic fresh-water fauna and a poor but characteristic flora. The outstanding accomplishments of the "Nimrod" party, however, were the ascent to the summit of Mt. Erebus (13,300 ft.) and the exploration of its active crater, the attainment of the south magnetic pole, and the memorable trip on which Shackleton advanced to 88° 23′ south, outdistancing his earlier advance with Scott by a greater step than had ever previously been made toward either pole. The four members of the polar adventure started from Cape Boyd on October 29, 1908. During the southward march three of the Manchurian ponies were successively shot as their strength failed, the flesh being cached for the northward trip. The loss of the last pony in a crevasse was apparently the incident which, by depriving the four men of indispensable food, prevented complete success. On January 9, 1909, Shackleton and his comrades left their sledges and tents, and that day planted British colors on the lofty Antarctic table-land ninety-seven geographical miles from the South Pole.

The return of seven hundred miles to the "Nimrod" was a terrible ordeal. Time and again the four men, who now replaced their beasts at the heavy sledges, ran completely out of food hours before reaching the next depot. They nevertheless hauled out rock specimens from farthest south. Shackleton returned to England without a casualty to report,

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SIR ERNEST SHACKLETON
A photograph taken after a luncheon of the Explorers' Club of New York, in 1917

and received from the king the first knighthood which had been conferred for Antarctic exploration since the time of Sir James Clark Ross.

The ill-fated Transantarctic Expedition of 1914 was the most elaborately planned of Shackleton's undertakings and at the same time the trip which tested his indomitable spirit to the utmost. As described in *South* it is also one of the most human and stirring of polar experiences. His principal object was to cross the Antarctic Continent from sea to sea. The splendidly equipped steamer "Endurance" met the ice in December, 1914, not far from her first southern base at South Georgia, and, after tracing a part of the continenta.

A panorama of Grytviken, where Shackleton died, and where he is buried. On the spit at the left is the Argentine meteorological station. Behind the coast hills loom the South Georgian Alps, culminating in Mt. Paget (8383 feet)

coast line, was caught in the floes of Weddell Sea, to be held in the pack until she was crushed, ten months later, east of Graham Land. The crew continued to drift, launching their boats in open water only on April 9, 1916. Six days afterward they landed at Elephant Island, of the South Shetland group.

Throughout the long, weary drift Shackleton carried on his person a page torn from the Bible which Queen Alexandra had given the ship. The leaf was from the Book of Job and contained the verse:

Out of whose womb came the ice?
And the hoary frost of heaven, who hath gendered it?
The waters are hid as with a stone,
And the face of the deep is frozen.

From Elephant Island Shackleton at once set forth upon one of the most remarkable of ocean voyages. At the beginning of Antarctic winter, he and five companions sailed in a twenty-foot boat across a tempestuous and snow-darkened sea toward South Georgia, three hundred miles to the northeastward. After a journey of many days, the terrors and sufferings of which can hardly be exaggerated, the crew of six landed under extraordinary difficulties on the windward coast of South Georgia. Shackleton and two of his men then crossed the all but impassable mountains of the island to the Tonsberg whaling station. This goal attained, he had no time for relaxation. The world is familiar with his three desperate but futile attempts to penetrate the ice pack toward Elephant Island, and with the final and successful effort in a Chilean tug, which resulted in the rescue of the marooned men.

The British Oceanographic and Subantarctic Expedition, of which Shackleton was in command at the time of his death, had strictly scientific rather than polar aims. The "Quest" a vessel of but a hundred tons net, was equipped with wireless, modern instruments for hydrographic work, and a seaplane. Her crew was made up entirely of picked scientific men. Shackleton intended to explore several thousand miles of seacoast, chiefly in the African Quadrant of Antarctica; to search for new coal de-

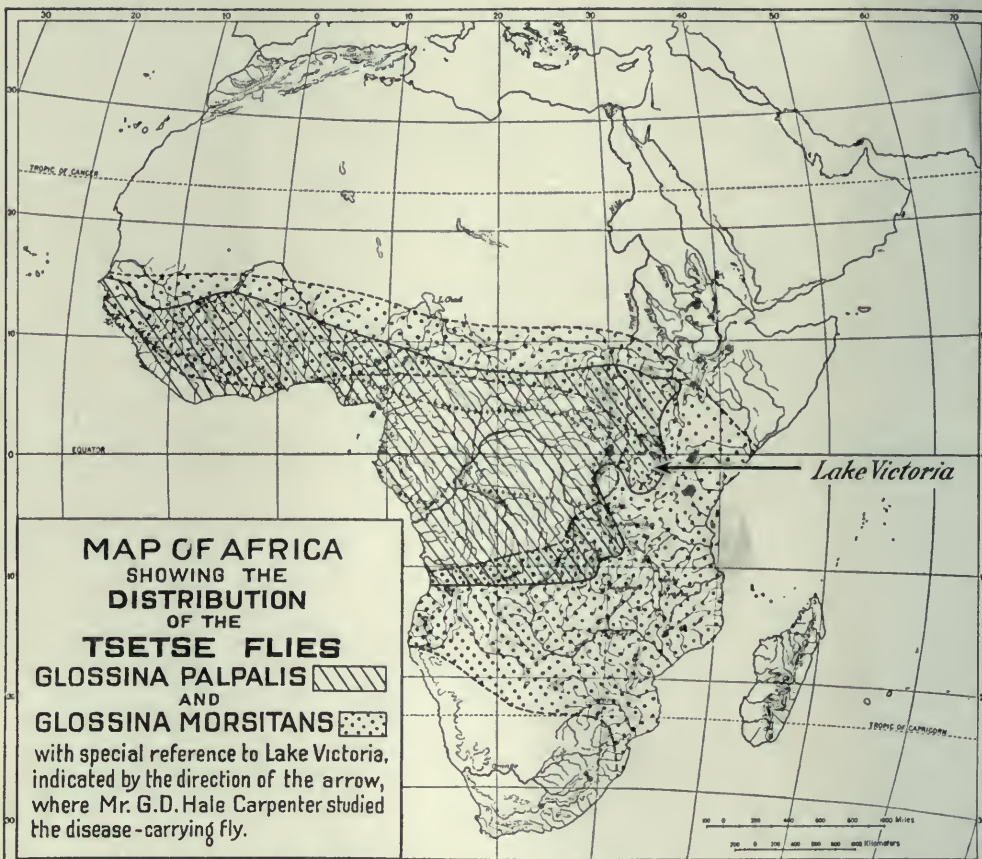
The brig at anchor is the "Daisy," of New Bedford, in the service of the American Museum. At the head of the cove lie the buildings of the *Compañia Argentina de Pesca*, the first modern whaling station in the Far South. Photographed by Robert Cushman Murphy

posits and for harbors which might serve as whaling bases; to find an island suitable for a South Pacific radio station; to make biological collections, gather meteorological and magnetic data, and to carry on extensive oceanic surveys, including deep-sea soundings. Under the able direction of Commander Frank Wild, who has had the best of Antarctic experience with both Shackleton and Mawson, the staff of the "Quest" may yet hope for a large measure of success.

Sir Ernest Shackleton was an honorary fellow of the American Museum of Natural History, and the recipient of many similar honors from learned societies in this country and abroad. Following his return from Scott's voyage, in 1904, he served for a time as secretary of the Scottish Geographical Society of Edinburgh. Other activities not directly concerned with his field exploration include an unsuccessful contest for a seat in Parliament and the direction of military equipment and transport during the North Russia Winter Campaign of 1918–19. He was the author of *The Diary of a Troopship* in addition to his two more widely known books, *The Heart of the Antarctic* and *South.*

On February 15, 1922, which would have been Shackleton's forty-eighth birthday, the rough board coffin in which his body had been brought from South Georgia to Montevideo was placed on an Uruguayan man-of-war to be returned to the icy island which had been associated with some of the most dramatic moments of his career. His interment on the shore of Cumberland Bay, South Georgia, was directed by Lady Shackleton, and was in accordance with the explorer's expressed wish. It is peculiarly fitting that he should rest on the threshold of the Antarctic, for it was at South Georgia that he spoke from his heart, after the moral conquest of 1916, as follows:

"We had 'suffered, starved and triumphed, groveled yet grasped at glory, grown bigger in the fullness of the whole.' We had seen God in His splendors, heard the text that Nature renders. We had reached the naked soul of man."



The tsetse flies (genus *Glossina*), of which some twenty species have been described, are at present restricted to the African continent, south of the Sahara, and to the extreme southwestern corner of Arabia. All species can act as carriers of the germs of various kinds of trypanosome diseases in man and animals, but the map, prepared by Dr. J. Bequaert, shows the distribution of the two which are of foremost importance in this respect.

The area occupied by *Glossina palpalis*, the usual carrier of "African human sleeping sickness," includes the whole of West Africa from the mouth of the Senegal River to Benguela and extends eastward to Lake Victoria. The partiality of this species to the moisture and dense shade of forested river banks accounts for its prevalence throughout the Rain Forest, the limits of which are shown on the map by a light, interrupted line of crosses. Outside this forest belt it is restricted to the well-wooded shores of water-courses and lakes, below 4,000 feet.

Glossina morsitans, the fly spreading *nagana* or trypanosomiasis in domestic animals, is a denizen of the savannah country; it avoids the Rain Forest but is found throughout the forested grass plains and low plateaus of the Sudan and East and Central Africa, as far south as the Tropic of Capricorn and Zululand. By predilection its haunts are certain "fly-belts" or patches of thick bush, sometimes of very limited extension and often sharply defined. In certain parts of Rhodesia, *G. morsitans* transmits a very virulent form of sleeping sickness in man, different from the West African and Uganda disease carried by *G. palpalis*

A NATURALIST ON LAKE VICTORIA: A REVIEW*

BY

JAMES P. CHAPIN[1]

SO NOTEWORTHY a volume on field zoölogy in Uganda as the one by G. D. Hale Carpenter here reviewed could scarcely have a more appropriate title than *A Naturalist on Lake Victoria.* Its purpose is to give an account of the life on the islands of Lake Victoria, and this purpose it fulfills admirably. I have seen it hold the attention of field workers who have carried on similar researches in adjoining regions, and for the general reader it should prove a pleasing introduction to African natural history.

Officially Dr. Carpenter went to Uganda to study the life history and ecology of the tsetse fly, *Glossina palpalis,* the insect that carries the deadliest disease peculiar to Africa,—sleeping sickness. Dr. Carpenter chose a most fitting, if dangerous, spot for his endeavors, the Sesse Islands in the northern part of Lake Victoria, the population of which had been decimated by the pestilence only seven years before. Those natives that survived had been banished subsequently to safer parts of the mainland. Were sleeping sickness an ordinary disease, an uninhabited island might offer little risk to a new arrival. The fact is, however, that the germ of this disease, a flagellate protozoan known to science as *Trypanosoma gambiense,* continues to multiply in the blood of infected sitatunga antelopes, causing no harm to the beasts, yet preserving its deadly virulence to man if transferred to his blood by the biting tsetse fly, the dangerous intermediary. Unless the antelope can be entirely destroyed throughout the region—and provided always that no other animal is found to harbor the dread *Trypanosoma*—the Sesse Islands will probably remain uninhabitable, for as yet no radical therapeutic control of the disease is possible and extermination of the fly hardly likely. This will give some hint of the risks undertaken by an entomologist making the tsetse his special subject,—risks confirmed by the subsequent infection of three of Carpenter's native employees with *Trypanosoma gambiense.*

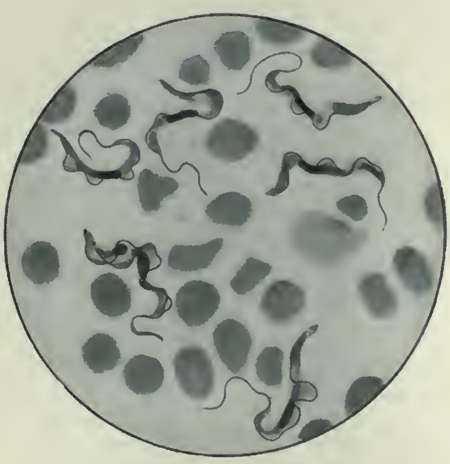
Glossina palpalis, the usual carrier of African human sleeping sickness. (Enlarged to almost three times natural size.) Above, fly with wings extended; at rest the wings are folded scissor-like above the abdomen. Below, fly in biting position; the dotted line indicates the extent to which the abdomen swells when the fly has fed to repletion

Two most instructive chapters are devoted to the natural history of the disease and its carriers, with special emphasis on the supposed origin of try-

**A Naturalist on Lake Victoria.* By G. D. Hale Carpenter. With 2 colored plates, a map, charts, and 87 illustrations, pp. I-XXIV, 1-333. New York, 1920, E. P. Dutton & Co.

[1]Assistant Curator of African Birds, American Museum

panosomiasis and the possibility of destroying an essential link in the vicious cycle of infection and reinfection, namely the fly. All trypanosomes are not pathogenic; they are found all over the world, especially in the blood of vertebrates and in the digestive tracts of invertebrates, but only in the case of relatively few trypanosomes can it be shown that they cause any ill to the host. Well do I remember our interest at college when our professor broke off the end of the tail of a common American newt, to show us the large trypanosomes swimming corkscrew-like in the drop of blood that exuded. The newt, like so many



Stained preparation of blood showing the germs of African human sleeping sickness (*Trypanosoma gambiense*). Magnified 900 times. (After Roubaud)

other animals, has developed a virtual immunity from its particular breed of trypanosome, and man is not affected by that species causing *nagana*, a deadly affection in cattle. But one's interest is of a very different sort from that experienced in the college class room when the doctor, examining one's caravan of African porters, feels for enlarged lymphatic glands in the neck, an early symptom of sleeping sickness. One is apt to go off fingering one's own neck and wondering how many tsetse bites, according to the law of probabilities, will make a case of disease. Carpenter tells us happily that in Uganda only from 2 to 11 per cent of *Glossina palpalis* were found to contain trypanosomes, but these trypanosomes included two species harmless to man, and of course there is many a chance that a possible infection may not "take."

Glossina palpalis is a good illustration of the influence of vegetation and humidity on the distribution of animal life in Africa, for, as shown on the accompanying map, the insect occurs only in the "West African" subregion, on the eastern edge of which lies Uganda. So the center of dispersal both of fly and disease may be said to lie rather in the Congo basin; and the reason for this limited distribution is seen in the necessity of a certain temperature and abundant moisture for the development of the pupæ as well as for the comfort of the adult fly. Yet the related *Glossina morsitans*, carrier of *nagana*, is just as typically a "savanna" creature, shunning the denser forests, although requiring very definite conditions of shade and humidity for its pupal development.

Carpenter's exact methods of studying the abundance of adult flies were based on the average number that could be caught by one black boy in an hour. Since the females when not hungry are less active than the males, the best index to conditions is the abundance of male flies, which may attain 125 per "boy-hour." If to this capture of males were added the females caught during a similar interval of time, the total would be increased by at least one fourth. A locality so thickly infested would not be a very comfortable one in which to tarry, but the figure cited is a maximum and the species in question does not feed at night. The other species of *Glossina* that do occasionally bite at night are far from common. During two years in the Ituri District I was bitten on only two occasions by

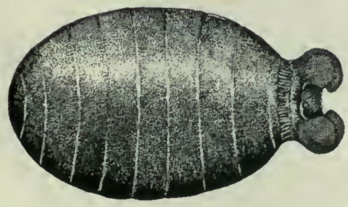
 

Photographs by H. Lang

To the left, a fine adult male of the West African sitatunga (*Tragelaphus spekii gratus*), a close relative of the form which in Uganda plays so important a part as a reservoir or natural host of the germ of sleeping sickness. Though widely distributed along certain swampy portions of the Congo basin, Cameroon, and Angola, these antelopes are rare in collections. To the right, a picture of their typical haunts on the Bima River in the southern Uele District, Belgian Congo. These antelopes can spread wide their long hoofs, thus preventing their sinking too deeply into the muddy ground while browsing on various plants of the undergrowth along the forest brooks tsetse at night, and on those occasions I was carrying a lantern.

Since the secondary host of the sleeping sickness "germ," so far as known, is always a mammal, it is important to know the percentage of mammalian blood in the food of the tsetse. This varied, Mr. Carpenter states, according to the abundance or absence of mammals on islands or mainland from 4 to 31.5 per cent, but the principal source of food, as proved by measuring the red corpuscles in the stomachs of flies, turned out to be the monitor (*Varanus niloticus*), with the crocodile a close second, and avian blood twenty-five times scarcer than reptilian.

Even if the sitatunga antelope above referred to could be exterminated, which Carpenter doubts, other mammalian hosts might be found, and it seems simpler to aim at the extinction of the fly. The natural checks on its multiplication, either parasitic or predaceous, do not seem sufficient to accomplish such a result, indeed it could hardly be hoped for. Birds do not often eat the adult flies, as I can state also from experience in the Congo, for the examination of some five thousand stomachs taken from more than six hundred species of birds did not reveal a single tsetse so far as my rather hasty examination brought out. If any African birds do eat the tsetse, however, it should be the gray, riverside flycatcher of West and Central Africa, *Alseonax lugens*, and the swallow, *Hirundo nigrita*, which I recommend for special investigation by future workers.



Pupa of *Glossina palpalis* showing the two tumid lips enclosing a deep pit at the posterior extremity. These protuberances are typical of the pupæ of all tsetse flies

Cutting off the forest and even low brush from the moist areas near habitations and roads has long been recommended and even practised in parts of equatorial Africa, for the control of the tsetse fly,—a course of action based upon the predilection of the adult fly and pupa for moisture and shade. Unlike most other flies, the species of Glossinæ do not lay eggs, but are viviparous, giving birth to a few, large, active larvæ, which immediately burrow into the soil and pupate. In the case of *Glossina palpalis*, the requirements of these pupæ are briefly summarized by Carpenter as follows: "Loose, dry soil, well shaded, but with the surface thoroughly ventilated; within a few yards from the water but beyond its reach." Spots meeting all the requirements are often much rarer than one might expect. Especially is this true within the confines of the great Congo forests, as in the central Ituri, where sleeping sickness has never taken hold. A sitatunga is found there, but neither are the flies very numerous nor is the human population very dense.

Carpenter proposes an ingenious method of destruction. Construct low, thatched shelters, he says, that will offer ideal conditions for the flies to deposit their young, then collect and destroy the pupæ at regular intervals. He has reason to believe that even the natural "loci" will be abandoned in favor of the more tempting artificial ones and that really valuable results may thus be secured. The whole idea is based, of course, on the abnormally slow breeding of the *Glossina*, a single egg being hatched within the abdomen of the mother and the larva fed by the secretion of special glands before it is finally extruded; in the case of almost any other fly the proposed procedure would seem ridiculous; but no one, it may confidently be stated, is a better judge in this matter than Dr. Carpenter himself.

Photograph by H. Lang

Typical breeding grounds of *Glossina palpalis* on an island in the Congo River near Zambi. Among dry leaves on the deeply shaded, raised river bank the gravid female flies deposit their full-grown larvæ one at a time; these burrow in the underlying layer of loose sand, pupate at once, and develop into adult flies about three weeks later

Besides considering the sleeping sickness question and the general natural history of Lake Victoria, Dr. Carpenter has somewhat of an ax to grind, not entirely his own, since it is concerned with mimicry among insects, especially Lepidoptera, with which Professor E. B. Poulton and Dr. Karl Jordan have been so prominently identified. Professor Poulton has written a preface for *A Naturalist on Lake Victoria.* Among the points of greatest interest he lists the investigations of Dr. Carpenter concerning *Papilio dardanus*, a swallowtail butterfly with a typical male but frequently with very different females mimicking certain other common butterflies of the regions in question, and Dr. Carpenter's confirmation, by breeding experiments, of Dr. Jordan's conclusions with regard to *Pseudacræa eurytus*, a single highly variable species of butterfly producing a wonderful series of mimics that copy certain other butterflies in different regions.

The reasons for mimicry among insects are still in dispute, its exact operation is still a subject of debate, but the superficial resemblances often seen between comparatively unrelated groups fall little short of the marvelous. It was H. W. Bates who first attempted an explanation of the subject, based on the fact that true mimics are very conspicuous in their natural surroundings, and that the models are common but supposedly distasteful species.

This question of mimicry is a subject quite distinct from that of protective coloration, of which so much has been written in America, stimulated particularly by the Thayers, and which Carpenter also discusses. In spite of the statements so often repeated, Gerald Thayer does not, of course, believe every animal to be protectively colored, any more than could those who have so often dissented from his views pretend that no animal is protectively colored. All of us have been struck by extreme examples of "procryptic coloration," as Poulton has termed it; and on the other hand, entomologists have long wondered at the parallel series of Lepidoptera which one can assemble in any tropical country, nay even in temperate climes, for North America has its milkweed butterfly (*Danaus archippus*) and its mimic (*Basilarchia archippus*), the one abundant[1] and evidently distasteful to birds, the other belonging to a different family yet strikingly similar in color, pattern, and general outline. The presumption is that the whole group to which the mimic is genetically related is preyed upon by birds and other enemies, but the mimic itself escapes their unwelcome attentions when once they have learned the disagreeable taste of its model.

For a long time, therefore, natural selection has been invoked to explain the survival, if not the origin, of the models and their mimics, the latter being selected, because of the above-mentioned advantages, from random variations in color. Those which closely resembled distasteful species were spared, the less-favored variants were consumed, leaving fewer and fewer offspring till definite mimetic strains became established.

What are the special enemies from which mimicry in butterflies protects the mimics? The triangular notches so often observed in butterflies' wings are doubtless in many cases the marks of birds' beaks, yet it has been denied—even by field naturalists—that birds eat butterflies in any appreciable numbers. The late F. C. Selous remarked that in Africa he did not once see a bird eat a butterfly; but he could scarcely have watched the African wagtails with much attention. These terrestrial birds eat insects and their larvæ in great variety, seizing flies in the air with an audible snap of the beak; they very frequently take butterflies, and may be seen shaking them vigorously to get rid of the wings. Many butterflies have a tendency to crowd in damp spots near water; consequently as one crosses a brook along an African trail, detached butterfly wings are often seen on the banks,—discarded fragments of the feast enjoyed by the wagtails. Even in the stomach of a heron (*Ardeola ralloides*) I have found as many as twenty small butterflies.

Photograph by H. Lang

African pied wagtail (*Motacilla vidua*).—Professor Poulton's disciples contend that this bird is one of the most potent factors in the production of mimetic forms among butterflies, insects on which it preys extensively. Doctor Carpenter relates how he observed the wagtail taking its pick from a mixed assemblage of butterflies that had alighted on the ground. He states that it never attempted to eat the members of certain groups reputed to be distasteful

[1]During the past three years this insect popularly known as the monarch has been of very limited occurrence in the neighborhood of New York. See NATURAL HISTORY for July-August, 1921, p. 438.

Marshall, Swynnerton, and Carpenter have all furnished abundant evidence that in Africa birds do eat butterflies. Doubtless much remains to be done toward establishing definite preferences on the part of the birds, but that they prey on butterflies can no longer be denied.

Since the development of the theory of mutation and studies in Mendelian inheritance, some doubt has arisen as to the continuous, random variation in color among the prospective mimics. It might be that the various mimetic lines are the direct result of mutation, and that these forms, if crossed, do not blend, but simply reassort their characters, always remaining clearly distinct. In such a case natural selection would not be essential to explain the similarity between model and mimic; this might be purely fortuitous, or the result of some factor, genetic or environmental, which caused parallel mutations in both series.

As Carpenter is a disciple of Poulton, one might expect him to combat the mutationist view, and this he does with considerable skill, not from an "armchair" point of view but as a most observant field naturalist. He relates the details of many observations and experiments to prove the reality and effectiveness of "aposematic" or warning coloration, and then, to show that species possessing such advantages have, nevertheless, many enemies to hold them in check, he states the case for any particular species of insect which is holding its own, without marked increase or decrease. The same number of individuals must continue to survive their combined enemies, vertebrates, predacious and parasitic insects, and the microörganisms of disease. If warning coloration or distasteful odor protects a species from vertebrates, it may almost be taken for granted that some of its other enemies are more menacing. Such a species, without this partial protection would doubtless already have been exterminated.

If insects not distasteful in themselves derive an advantage from a close resemblance to distasteful forms, it seems also likely that two distasteful species are better protected by the possession of a common warning color, especially if their enemies must learn their disagreeable qualities by experiment instead of avoiding them instinctively. A bold marking with orange-brown and black, is a type of coloration found through many orders of insects both in Africa and the East Indies, and has been named "lycoid" from a family of distasteful beetles that possesses it.

Since the butterfly genus *Pseudacræa*, which Carpenter studied especially, is believed to be partially distasteful to birds, he is obliged to admit that its resemblance to acræines and danaines, which are more pronouncedly distasteful, may be considered as a transition between common warning colors and mimetic. Briefly stated the case is as follows: a single polymorphic species *eurytus*, of the genus *Pseudacræa*, was formerly believed to represent seven distinct species (thirteen named forms in all), and imitates thirteen distinct species of *Planema*, among the acræinæ. In practically every case model and mimic have been found in the same localities.

The idea that all these forms of *Pseudacræa* must belong to a single species first occurred to Dr. Karl Jordan in 1910 after an examination of the male genitalia, and its proof was delegated to Carpenter by Professor Poulton. A few intermediates had been found, to be sure, between some of the forms, but these were rare until Carpenter began collecting on the islands in Lake Victoria. Here transitional forms were found in numbers, and the *Planema* models were relatively scarce. Between these two facts Professor Poulton saw a causal relation: where the models are of comparatively rare occurrence, the intensity of selection affecting the mimics must be relaxed, allowing intermediates to survive. This was tested out by Carpenter in a statistical study which shows that the proportion of intermediates between strictly mimetic forms of *Pseudacræa* varies inversely as the proportion of *Planema* models in the total captures of butterflies.[1] For this purpose, of course, all the specimens observed must be caught and counted indiscriminately. Just why *Planema* should not thrive on the islands of Lake Victoria cannot be completely explained; but the relative scarcity of insectivorous birds on some of the islands may also play a part in the working out of selection.

The direct proof of specific identity for these forms of *Pseudacræa eurytus* was secured by rearing broods from nine different females. Among these broods were found not only many intermediates, but also offspring quite different from the female parent, two different "races" or even more intermediates sometimes appearing from eggs of a single female. In all cases the male parent was unknown, for it was not possible to mate the butterflies in confinement, and even then the experiments had to be carried on in the forest to avoid fatalities from lack of humidity. Exact genetic data could not, therefore, be secured; it was simply shown that the named varieties were not Mendelian entities, or at least not single factor differences.

Too much emphasis is laid, perhaps, on the difference between the Darwinian and mutationist points of view. Heritable Mendelian characters may certainly differ so slightly at times as to approach fluctuating or "continuous" variations, and in any event it may be stated that Carpenter has presented an excellent case for the operation of natural selection in the origin of *Pseudacræa* mimics.

The eight other chapters of Carpenter's delightful volume are devoted to a general description of Lake Victoria and its animal life. They are not arranged primarily in narrative form, but classified rather as to subject. This has its advantages, for it makes the reference to certain groups of animals more feasible. Take, for example, the chapter on birds, which naturally interested me as an ornithologist most of all, since the birds of Uganda and of the eastern Congo are in so many cases the same. Dr. Carpenter has especially disclaimed intimate knowledge of vertebrate zoölogy, ornithology in particular, yet he has a vivid way of describing the appearance and habits of Uganda birds that would do credit to a book dealing only with the birds of that region. A semipopular book on Central African birds is heartily to be desired; in 1911 the van Someren brothers attempted this for a score of the commoner species,[2] and we fervently wish they could extend it so as to cover a larger part of the abundant avifauna. How much more would travelers and sportsmen observe and report to the scientific world if their interest could be stimulated by a portable, readable work of this sort.

When the author attempts to apply Poulton's theory of aposematic coloration and behavior to a large hornbill (*Bycanistes subcylindricus*) I am forced to dissent. This bird can display itself openly because of its large size, and a peck from its enormous beak would suffice to keep any bird of equal size at a distance. I am not sure that hornbills are as a rule distasteful, I have known *Ortholophus cassini* in the Ituri Forest to be killed and eaten by a hawk no larger than itself (*Astur toussenelii*).

The chapter on mammals is written in the vein of the animal lover rather than in the spirit of the hunter. In it will be found an excellent study of the "speech" of one species of monkey, a common *Cercopithecus* living on the larger islands of the lake. This well shows the extent to which a monkey can express its feelings by sound, and is far more convincing than all that a more widely known writer

[1]On p. 267, of his volume Carpenter offers a very convincing chart covering this point.

[2]*Studies of Birdlife in Uganda*, London, 1911, 22 pages, 25 plates.

on the subject has ever been able to tell us. After all, monkey language is very different from articulate human speech and its range is comparatively limited, fourteen different sounds being listed in the present instance. It is a prime requisite in such studies that each species be studied individually, for as any naturalist knows who has visited Africa, the calls of monkeys are just as distinct, specifically, as are those of birds.

The period covered by Dr. Carpenter's book was unfortunately interrupted for four years by his active service with the Army in East Africa, and of his observations during this time he gives us scarcely a word. Perhaps it is not too much to hope that he may be preparing a second volume about those experiences, and in such a case, we may well guarantee it a hearty welcome.

Photograph by H. Lang

Segregation camp for sleeping sickness patients at Aba, near the northeastern frontier of the Belgian Congo. The small brick houses in which the patients are isolated have been built on high ground away from any watercourse where tsetse flies might live, so that none of these insects can become infected with the trypanosome and thus transmit the disease from sick to healthy natives. For the same reason the brush and trees which could shelter tsetses, have been cut away

AHUREI BAY

As one looks to the east from a vantage point on one of the old hill forts on Rapa Island, this beautiful enclosed bay, with scattered taro beds growing on its southern shore, shows clearly

A VISIT TO RAPA ISLAND IN SOUTHERN POLYNESIA

BY

ROLLO H. BECK*

RAPA ISLAND, the most southern of the Eastern Polynesian Islands, was one of the places I wanted to visit, and the good ship "Pro Patria" was the means of reaching it. After several weeks of sailing, broken only by three landings made on islands of the Austral group, I was glad to step ashore on Rapa one April morning last year. The hour was fairly early, but the islanders were already astir, preparing the morning meal. Obstructing my line of march were taro beds, where the mud in places reached above the ankle; so, slipping off my shoes and shouldering my camera, I started barefooted over the uninviting ground. After wading through the last mud puddle I washed my feet in a clear stream of water, put on my tennis shoes, and started off on a well-marked trail through the coffee trees toward the ancient fort that was my objective.

Above and some distance beyond the coffee trees I passed several little patches of taro. A few dozen plants growing on a leveled place in the steep cañon reminded me of potato patches I had seen in Peru in 1913, where a dozen plants, protected by a well-built stone wall of Inca origin, sometimes constituted the entire crop. Banana plants in groups of twenty or more were distributed here and there in the cañon. Coffee trees were growing on a low level, near its mouth, whereas in most places they grow well up on the hillsides.

Climbing up, knee-deep, through ferns, I soon reached the top of the ridge near the fort, toward which in bygone days others had marched with more sinister intent. Four different levels on top of the ridge had been protected by built-up rockwork and on the highest point a solidly constructed wall had been erected as a last stronghold. Just below the top on a leveled terrace 40 x 40 feet, a small hole had been dug, probably to catch rain water.

Four miles away in an air line, two other forts showed up against the sky. All were so built that if besieged a small force within could hold at bay an attacking force several times its number, provided food and water held out. The only approach was by the ridge, as the sides of the mountain were too steep to climb.

Down to the eastward, the beautiful enclosed bay of Ahurei, with the scattered taro beds lining the head of it, showed clearly, while high above the village wild goats could be distinguished ranging the craggy tops of the ridge. Just to the southward of the fort the ridge runs up to nearly 2000 feet, forming a sharp backbone of unclimbable cliffs, while to the west and north other ridges with narrow valleys between cut the island into sharply defined districts. Wild pigeons were cooing in the cañons below as I descended and stopped, after the steep climb, to refresh myself with a bath in a rocky, water-worn basin, prior to my returning aboard the "Pro Patria," there to change to Sunday gear before joining the crew ashore for luncheon.

I found the captain and his wife, the mate and his wife, and the supercargo enjoying the garden of the French administrator, where a bearing fig tree and orange trees weighted with juicy fruit invited attention. In another month the ripening oranges would no doubt furnish a pleasant addition to the meals of poipoi, the principal food of the islanders. A splendid crop of tobacco was maturing in a small grove and bore witness to the rich soil and favorable temperature.

*Leader, Whitney South Sea Expedition

While we lingered in the garden, the chief's son, his wife, and two daughters, arrived to lead us to his residence. In our walk thither we were followed by a dozen of the ubiquitous children of the island, some in shirts, some in *pareus*, one in the discarded vest of some itinerant visitor, and several of the younger wearing nothing at all. As we entered what I supposed was the residence of the chief's son, the supercargo warned us to eat lightly as we would be expected to partake of food at several other places as well.

Fresh banana leaves were laid in a long row across the mat-covered floor and at each place was a plate containing one or two whole fish, a plate containing several large pieces of juicy pork, and at one side of the plates a large taro root. Sitting down in the most comfortable position on the mat, we ate with the aid of our fingers, for at none of the houses were the common table accessories known to civilization provided. As the first few pieces of fish gave way to the pork, the serving maids brought in the poipoi neatly enclosed in the broad green leaves of the rauti plant. The poipoi looked to me like wet, sticky dough with a lot of yeast in it, and that is the way it felt too. As this was my first experience with the food, I nibbled it rather gingerly, but the rest of the party, using two fingers as tongs, would separate from the mass a good big finger-load and, holding this deftly poised for a moment before the open mouth, would presently gulp it down with the aid of a swallow of water. Opposite to me a girl grasped a handful from the quantity lying on the leaves, dropped it into a bowl of water, and, dividing it into four pieces, swallowed the several morsels in the space of not more than ten seconds.

While we were still engaged in eating, the son of the chief appeared in the doorway and advised us to hurry, as dinner was awaiting us at his home. So, leaving the untasted residue of the feast, we walked across the lane to his abode where a similar repast awaited us. In addition to the fish, however, there was a lobster cooked whole, and in place of one taro root, there were two large ones. A tumbler of water, too, was provided for each guest. The meal was well under way when the captain leaned back from his partly eaten lobster, which had been about two feet long in life, and, in deference to his leadership we all slacked up and presently ceased eating.

We passed out along the lane to a smaller thatched cottage and found within a repetition of the repast offered at the houses previously visited, except that in place of the pork, a deliciously cooked chicken had been prepared. The supercargo again reminded us not to eat too much as we would need a reserve of appetite at the chief's place, to be visited next. When presently we strolled up to his large hut, the chief was awaiting us with his wife and three or four girls in the open yard before the door.

In this home again lobster, pork, and chicken were waiting—as a last test of our capacity. The amount of taro had increased to three big roots, although a few pieces broken off the small end of one root would easily have sufficed for a meal. In addition, the chief had coconut milk in which to dip the meat and roots, a rare dish in Rapa, as coconuts are not grown there and nuts are obtained only when a ship from the northern islands calls, which happens but seldom. We were also served with molasses, not greatly dissimilar in looks and taste to the dark cane molasses used largely for cooking in the United States. This local syrup is made from the roots of the rauti plant, the leaves of which are used to wrap the poipoi in, as well as fish, fowl, and other meats cooked on hot rocks. The molasses was placed on the plate with the poipoi, and we found that the poipoi could be more easily swallowed with the aid of the dark fluid than with that of water, the usual liquid taken with the pasty substance.

At the conclusion of the meal, bananas were passed around. While the others lit cigarettes and talked, I sat back and watched the changing assemblage of children in front of the open door and window, waiting for a favorable moment to pick up the graflex and take their pictures unawares. The chief, from his seat at the head of the table, watched with great interest the proceeding, and when we arose to go, he stepped outside with us and made it possible for me to take a picture of him and his family, with the younger members of several other families.

Although we had been told the population of the island did not exceed forty, we saw more than twice that number of individuals. The people are a hardy, energetic lot, the women working in the taro beds, while the men row several miles on their fishing trips. They obtain a variety of edible fish if the catches we saw on Saturday and Sunday, consisting of many specimens of different color and shape, are any criterion. While on board the "Pro Patria" one day, I was amused to see a fellow passenger, the former French Commissioner at Rurutu, fishing from the stern of the vessel and catching nothing, while tied alongside was an outrigger canoe with an old, decrepit native in it pulling up a sizable fish every few minutes.

A few of the fishermen, for our benefit probably, made a trip to the lobster beds at the entrance to the bay, and brought back a hundred lobsters to be cooked at the several houses we visited Sunday. Practically every house in the village entertained one or more of the crew during our stay of five days and after the luncheons and dinners of Sunday had been digested, the captain suggested that it would be a courteous act to present a case of kerosene for use in the church, the light of which shows up brightly as a ship enters the harbor. The next day a case of kerosene was taken ashore and delivered to the caretaker of the church. That the captain's gift was appreciated was proved the day we left the island, for package after package of poipoi was presented at the wharf by the families belonging to the church.

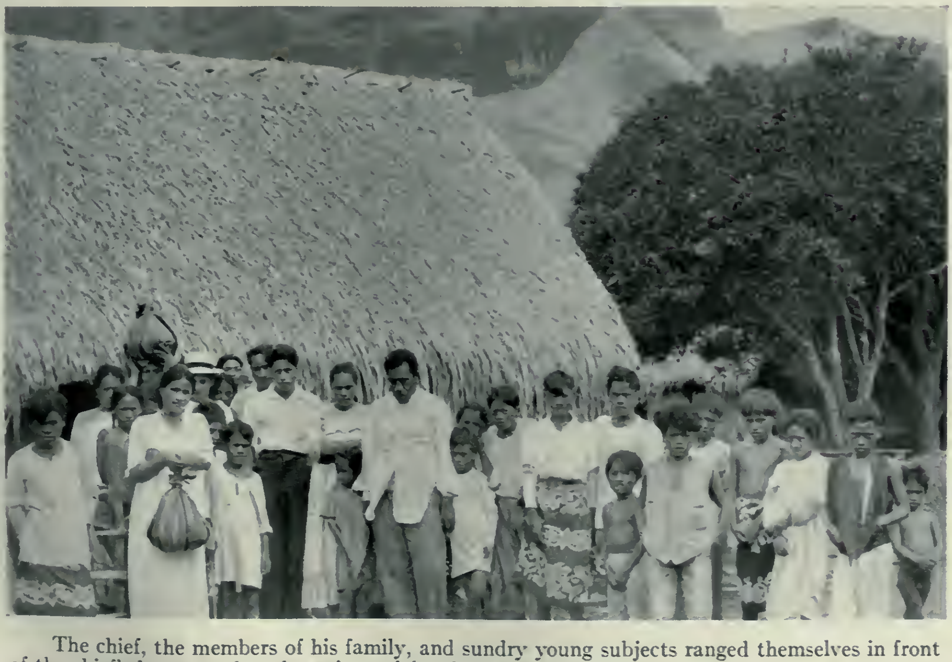
A GROWTH OF PAPAYA
This picture was taken in the Tubuai Islands

The taro plant, from which the poipoi is made, grows best in shallow water, somewhat after the manner of rice, though it is a plant of an entirely different character, looking like a big lily root when pulled from the ground or mud. The amount of work necessary to keep the beds free from grass becomes apparent when one contrasts the condition of beds temporarily abandoned with that of beds taken care of, and is proof of the industry of the women who tend them. The younger women and girls do most of the field work, while the older ones attend to the cooking at home.

On Rapa, food is cooked, as a rule, not indoors, but in the front yard

The boathouses as well as the family houses of the island are heavily covered with a roofing of thick grass

This conical structure, with its thick matting of grass, so suggestive of a haystack, is a native dwelling. Orange trees are a familiar sight near such habitations



The chief, the members of his family, and sundry young subjects ranged themselves in front of the chief's house so that the writer might photograph them

AN EXCHANGE OF GREETINGS

Daily the women and children paddle unstable-looking canoes to and from the taro beds on the northern shore of Ahurei Bay

EVENING CALM

From childhood the people of Rapa are trained to the life of the sea. Women as well as men are expert in handling canoes

At Rimitara and Rurutu islands, some hundreds of miles to the northwest of Rapa, the work of the women is limited largely to the making of mats and hats, while the men labor in the fields. At Rapa, however, the preponderance of women gives the men an enviable position. The exemption of the men from field work allows them more time for fishing and as a result of the sea experience thus gained they are much sought after by the captains of sailing vessels in Papeete.

We were astonished at the performance of the boat crews that came out to meet us three or four miles from the island. These crews had made no allowance for the fact that we had an engine that enabled us to speed up our sailing, and in less than a minute they were left a hundred yards astern. But when our cabin boy, a Rapa man, called to them to come up and be towed in they showed what they really could do, and though we were traveling at the rate of about six miles an hour, they were moving in the open sea at twice that speed when they neared the vessel.

A couple of instances noted during our short stay shows how they get their sea experience. One day I engaged a crew to row me about five miles to an islet where certain sea birds nested. Two of the members of this crew were only about thirteen years of age. However, we started out and, before reaching the ship again in the late afternoon ran into a heavy storm. The boys managed their oars during the hours of pulling against a head wind and rising sea as though they had been accustomed to the work for years. I frequently had to bail water from the boat, helping the youngster at the after-oar in the intervals, for he was handling an oar weighing about fifty pounds and the oar was poorly balanced—most of the oars being homemade and of native wood.

The day following this excursion we were on board the "Pro Patria," ready and expecting to sail, but the pilot and the barometer advised remaining at anchor. By three o'clock in the afternoon, with both anchors down and engine working, we were slowly drifting toward the rocky shore at the head of the bay, when a gust of wind a trifle heavier than that sweeping a pall of smoky-looking water across the surface of the bay caught the twenty-four-foot boat belonging to the pilot, which was fastened by a long line astern of us, and in a twinkling flipped it bottom-side up. The son of the chief, who was steersman, called to two of his crew and, pulling the overturned boat a little nearer the schooner, jumped with them into the bay, swam to the boat and, aided by his men, presently turned it over into its proper position. Thereupon the pilot cast the boat adrift and, with the three mariners clinging to it, it drifted to the shore, a few hundred yards astern of us. Arrived in shallow water, they managed to bail it out in an hour's time and then returned to the ship, in the face of a gale which was tearing in terrific gusts down from the mountainside.

We were somewhat surprised to see how extensively the unstable-looking canoes were used by girls and women, who several times paddled past the ship on their way to the taro beds a couple of miles across the harbor. In the evening they would return with a load of heavy taro roots weighing down the narrow canoe very nearly to the sinking point. From childhood these people become familiar with the ocean. A shallow depth of water stretches along the shore by the village and on sunny days children can be seen at all hours paddling canoes or playing in the water alongside the stone pier.

The whole population of the island, exclusive of a few lepers, who were confined to another valley, was living in this village or along the bay shore within a couple of miles of it. Five or six valleys that formerly supported villages are now deserted, but the stone forts

WHERE BANANAS AND TARO GROW

It is of taro that the natives make poipoi,—a dish relished by Polynesians but by few others. Because of its broad leaf, the taro plant is known in some places by the not inappropriate name of "elephant's ear." This picture was taken on Rimitara Island that protected the people living in those villages, still stand on the hilltops and can be seen from the sea as a vessel nears the land.

The second day after our arrival I went ashore early and passed the church on my way to the mountains just as the people were gathering for one of the tri-weekly morning services. A boy about twelve years of age espied me and, detaching himself from the crowd, raced after me and accompanied me or led me up and down a devious route till our return in the evening. We passed over the first ridge and then swung around and up the valley toward the center of the island, dipping down into little gullies where orange and lemon trees were growing beside shiny-leaved coffee trees, with groups of banana plants in the moister places, till we crossed the main cañon more than a mile from the sea. We found groves containing a few dozen coffee trees in the most unexpected places, among tree and brake ferns; these coffee trees had been planted in some depression after a fairly level spot had been cleared of underbrush and ferns.

In the bottom of the main cañon small beds of taro extended up into the narrow, rocky portion at the base of steep cliffs, two miles or more from the village on the other side of a high ridge. Why these beds should have been planted so far from the living quarters was puzzling, for there was considerable idle ground suitable for agricultural purposes much nearer the settlement, but possibly dry seasons made it necessary to have reserve beds near a reliable water supply.

We climbed upward from this cañon a thousand feet to the top of the next ridge and there, standing on top of one of the old grass-covered forts, I shot one of the native, green, fruit pigeons, the species on Rapa being the largest of the several species found on different Polynesian islands. As far as we could learn, it is the only native land bird, provided the cuckoo, which also occurs, is a migratory visitant from New Zealand, as it is believed to be.

As we worked down the razor-backed ridge, the barefooted boy would skip along over places on the goat trail that I would negotiate with extreme care.

The nest of the wild duck that inhabits several of the Polynesian Islands is found but rarely, as it is usually placed on a hillside some distance from the water. This nest was located in a thick patch of ferns

Thus by rapid stages we descended until we reached the shore, going past patches of forests on hillsides, where calling for pigeons would sometimes elicit answers from birds in the dense trees but seldom would induce the birds to come into view. There we found a clump of orange trees growing near an old hut used by the workers in the taro beds near by. We picked some of the oranges and ate them. Then we tackled another steep mountain-side where a forested area gave promise of pigeons, but the dense growth prevented our seeing them at a distance and we secured only one bird, making but two specimens for the day's trip. During our stay we managed to capture a dozen pigeons and several of the little black rails that live in the thick grass and feed in the open taro beds, the only places where they can be seen.

Early in the morning of what I supposed was to be the last day of our stay, I hastened ashore with the camera to get a photograph of a duck's nest which I had discovered a couple of days before. The crew of the rowboat meanwhile was busy taking on board the last sacks of coffee and a dozen goats caught by the natives in the mountains. These goats had been bought for the absurdly low sum of seven and a half francs each.

When I returned at ten o'clock, the boat was still being loaded with coffee, goats, poipoi, taro, baskets, and gourds, and every few minutes a woman would bring down yet another package. This continued up to eleven o'clock, when the rowboat made its last trip.

As we stepped aboard the "Pro Patria," a heavy rain began. Instead of setting sail as planned, we stayed in the harbor, fighting all afternoon the wind that, with hurricane force, swept across the water. Toward evening the storm abated and the following day we got under way and passing out of the narrow channel arrived abreast of Rapaita, the small islet just off the outer point of the harbor. There the pilot said "Fine," and relinquished the wheel to one of the crew. As the pilot called to his crew, "Harrimai pote" ("Come along to the boat"), the captain called out, "Fore staysail," and the pilot descended to the cabin to receive his pay. Presently he returned smiling to the deck, then dropped into his boat, which was pitching on the water alongside. As the pilot's boat dropped astern, the crew waved hands and hats. In the same way, from the rocky beach a mile outside the last house on the bay shore half a dozen girls had waved hats, hands, and *pareus* as we passed them. Speeded on our way with these farewells, we left the most hospitable people it has been my good fortune to meet.

A count of our acquisitions made on deck after leaving showed five sacks of taro, eighteen packages of the poipoi done up in leaves, nineteen boxes of taro and poipoi, fifteen bunches of bananas, twenty-two rabbits, and fourteen goats. While some of these had been purchased, the greater number were presents.

With a fair wind astern we lost sight of the precipitous mountain peaks in their enveloping fogs long before dark, but the memory of the happy days spent among the hospitable natives stayed in the foreground of our consciousness for some time.

THE UNFORESEEN IN INDIAN VOCABULARY WORK

BY

C. HART MERRIAM *

THE task of collecting and verifying Indian vocabularies, sentences, and texts has many attractions, many surprises, and many disappointments. Nothing would seem easier than the setting down of words and sentences obtained in response to such simple questions as: "What do you call a black bear?" "What is the name of this basket?" and so on. But when one comes to check up his results by other Indians he discovers undreamed of possibilities. When, for instance, he finds that the expression recorded for *get up* means "it's morning," that the name received for a particular basket means "dirty old thing," that the word recorded for *black bear* is "blackberry," the word for *hungry*, "I guess I'll eat," and others equally startling, he is reluctantly forced to admit that words obtained from Indians do not always mean what they seem.

In the case of words that are the names of definite objects—as fire, water, sun, rain, snow, bear, coyote, eagle, and so on—errors rarely occur, but in other cases seemingly similar one must be on his guard. Thus in many languages the word given for the particular river or mountain near which the Indian resides is not its specific name but the general term used in a specific sense—meaning *the* river, or *the* mountain, it being the one uppermost in the speaker's mind. The same is true of the tribal name, for in California the word given in reply to the question, "What is the name of your tribe?" is in many instances the word for people—meaning *the* people. Thus the commonly accepted "tribal names" Mewuk, Midu, Nissenan, Patwin, Win, Wintoon, Yahnah, and Yokots are in each case—in the language of the tribe speaking—merely the word for *people*, meaning *the* people = our people.

Words expressing condition—as sick, well, kind, unkind, happy, lonesome, and a multitude of others—are particularly dangerous, as the answers are likely to be sentences instead of single words.

Indians, like ourselves, often have several words for the same thing. It is important therefore to ask for additional words of the same meaning; otherwise, in comparing vocabularies from Indians of the same tribe, one may be misled by different words to suspect the existence of another dialect.

It appears, therefore, that however honest and well-meaning an informant may be, a vocabulary—and still more emphatically a collection of sentences—should be looked upon with suspicion until verified. If this is impossible, as when the informant is the only survivor, it is well worth while to go over the ground with him a second time, after a lapse of months or years. In this way, many errors are corrected.

In the course of work of this kind one has many interesting, many curious, and some exasperating experiences. Some Indians are naturally suspicious and avoid giving direct answers. Others feel that you would not ask directly and boldly for the answer you really want, but that your question should be taken as suggestive; so, after due consideration, you are given an answer which the Indian's imagination pictures as conveying the desired information—howsoever wide it may be from the word or expression you are seeking. Hence it is not to be wondered at that the reading of a vocabulary or text to another person of the same tribe nearly always results in startling discoveries.

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DECREASE OF FUR-BEARING ANIMALS IN ALASKA

BY

E. W. NELSON*

THE fur-bearing animals of Alaska form one of its most valuable natural resources. For a number of years, however, the fur bearers in that territory have been destroyed to such an extent that their future is seriously endangered. Since the development of black-fox farming, the practice of digging out the dens of foxes has been followed to such an extent that these animals have become almost extinct over considerable areas.

The den-hunter locates a den containing young foxes and then digs it out, taking any black or cross fox pups it may contain and abandoning the others. The freshly turned earth and disturbed condition of the surroundings frighten away the mother fox, with the result that the young, abandoned by the hunter and by their parent, are left to perish. It is also reported that many of the black and cross foxes which are taken from dens ostensibly for breeding purposes are merely held in pens until their skins become prime the following fall or winter, when they are killed.

In addition to this, the illegal use of poison has been continued by a considerable number of unscrupulous trappers, thereby intensifying the destruction, which over great districts amounts to virtual extermination of all the fur bearers. In some districts beaver houses have been opened in winter and the entire beaver colony killed for the skins.

This practice, combined with the intensive trapping encouraged by the exceedingly high prices of furs during the last few years, has greatly reduced the number of Alaska fur bearers. It is only by more adequate laws and a larger and more effective warden service that this depletion can be stopped. It is to the credit of many Alaskans that throughout the territory there is bitter antagonism over the killing of fur-bearing animals by the destructive methods mentioned above. At the same time there is no way of adequately controlling the evil under present conditions.

Owing to the fact that marten and beaver were seriously over-trapped and were in danger of extermination in large districts, several years ago, at the request of Alaskans, regulations were issued prohibiting the taking of beaver and marten over a considerable period in order that the country might be restocked. Such restocking had taken place in some districts, where these animals have been unmolested, but through connivance of unscrupulous persons, many trappers, particularly Indians, have been encouraged to trap illegally great numbers of both beaver and marten, and a large illicit traffic has been maintained in the skins of these animals. Numerous seizures of such skins have been made, but with the limited means available it has been impossible to stop the traffic, which persists because of the great profits involved. The demand for furs is so great that, with ordinarily high prices prevailing, the future of our fur bearers is seriously jeopardized unless stringent protective laws with proper limitations on the trapping season are made effective.

During the winter of 1919-20 one of the wardens of the Biological Survey made a round trip of about three hundred miles through a part of Alaska where foxes were once numerous, and saw the tracks of but one fox. Den-hunting and poison had cleaned them out.

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RAINS OF FISHES AND OF FROGS

BY

E. W. GUDGER*

WHEN my paper on "Rains of Fishes" was presented to NATURAL HISTORY,[1] I was asked if I could not furnish illustrations, and in reply I could only answer that the paper gave all the known accounts and that, so far as I knew, there were no such illustrations in existence. At that time I was actively searching, in an entirely different connection, for a curious and rare old book by a learned Alsatian named Conrad Wolffhart, who, in accordance with the fashion of his time, Hellenized his name into Conradus Lycosthenes Rubeaquensis. This book, *Prodigiorum ac Ostentorum Chronicon*, was published at Basel, Switzerland, in 1557.

No copy could be found in New York, nor was it in the Library of Congress. However, it was located in the Surgeon General's Library and application was made for its loan only to bring the answer that the book was too rare and irreplaceable to permit its being taken from the building. Later, by chance, a copy of this book was located in the Boston Public Library and the authorities there very kindly sent it down for my use. It arrived at the American Museum on the very day that the issue of NATURAL HISTORY containing my article on "Rains of Fishes" went to press.

On looking through this very interesting old tome I found one account of a rain of fishes and two accounts of rains of frogs, with illustrations, reproduced above, of both phenomena.

Lycosthenes tells us on page 367 that in the third year of the reign of Otho, the sixth emperor of that name (the year being 689 A.D.) there were tremendous meteorological disturbances, culminating apparently in a downpouring from heaven of little fishes in Saxony, this same downpour being illustrated by the figure reproduced above, it being, so far as known to me, unique.

With regard to the rain of frogs, our old author tells us on page 458 that in 1345 "rain mixed with frogs" fell in Germany. This phenomenon he illustrates with the very quaint figure here given—likewise the only one of its kind known to me. Again, on page 604, Lycosthenes tells us that in 1549, near the town of Colmar in upper Alsace, toads and frogs fell from heaven in such abundance that people killed them with clubs, and that later their dead bodies so infected the air that the authorities had them collected and carried away.

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[1]Gudger, E. W., "Rains of Fishes," NATURAL HISTORY, 1921, Vol. XXI, pp. 607-19.

NOTES

ASIA

In the midst of his duties as head of the Third Asiatic Expedition, Roy Chapman Andrews has found time to prepare a full account of activities in China, which will be featured in an early number of NATURAL HISTORY. In the meanwhile, his letters contain encouraging reports of the three groups of field workers there.

Of the two natives that remained in Shensi to continue the hunt for takin, Mr. Andrews writes on December 20:

"Last night my two hunters got back from Shensi. They got three more fine takin, one bear, one serow, one deer, one wild boar, and about two hundred small mammals—a really remarkable job. This gives us five splendid takin and insures a stunning group. This species has been shot by only about ten or twelve white men and is an exceedingly rare and difficult animal to get."

Mr. Clifford Pope has completed a two months' trip along the Yangtse River, where a fine collection of fish, reptiles, and batrachians, numbering about 4000, was secured, and is now collecting in the Tung Ting Lake district of Hunan. In his letter of January 1 Mr. Andrews reports:

"Pope has just telegraphed me from the Tung Ting Lake (Hunan) that he has a fine specimen of the remarkable porpoise described by Miller. . . . He called it *Lipotes* and it is really a 'living fossil.' Pope also has another fresh-water porpoise from the lake which must be new. These are really splendid acquisitions."

Although no report has been received from Mr. Granger, the fact that he is remaining for so long a time in Wauhsien where he located fossil "mines" late in October would indicate that these mines are yielding results.

Both in New York and in Peking preparations are under way for the Mongolian trip, which will occupy the spring and summer months. Mr. S. Bayard Colgate, in charge of motor transportation for the expedition, left New York on January 31 to sail from San Francisco February 7 on the "Empire State." He took with him the spare parts and other equipment required for the expedition's trucks and motors, including an important gift of tires and inner tubes presented by the United States Rubber Company. In March, he will be followed by Mr. J. B. Shackleford, motion picture photographer, who will reach Peking about April 1, in time to accompany Mr. Andrews into Mongolia. Professor C. P. Berkey, of Columbia University, is already *en route* to China where he will outline geological work. Until these men arrive from America, it will be necessary for Mr. Andrews to remain in Peking, where he is buying and packing supplies, equipment, and food, establishing stations in Mongolia and completing the detailed plans for the summer's work.

Unsettled conditions in Mongolia, where the "Red" government is in charge of Urga and the surrounding country, will make it advisable to secure assurances from the "Reds" that the party will not be molested. Mr. Andrews had feared that he would have to go in person to Urga, an unpleasant trip across the desert in midwinter, in order to make definite arrangements with the "Reds." However, in his last letter he says:

"The American Consul at Kalgan has gone to Urga in our behalf to see the 'Red' commander in Mongolia and the prospects are that arrangements will be made to obtain 'Red' protection so that we may use Urga as a base. If not, we shall establish a base right out in the center of Mongolia away from 'Red' influence."

SOUTH AMERICA

MESSRS. G. H. H. TATE AND GEOFFREY GILL, members of the American Museum expedition that under the leadership of Mr. George K. Cherrie has been collecting birds, mammals, and reptiles in Ecuador, have returned to New York, where they arrived on January 14, a few weeks after the home-coming of their invalided chief. They brought back with them a large number of specimens—2000 birds, 300 mammals, and 700 reptiles and amphibians—collected during their sojourn of six months in Ecuador.

It was Mr. Tate who accompanied Mr. Cherrie from the scene of his accident to Guayaquil, giving him such aid as he could on that nerve-testing trip. Subsequently he rejoined Mr. Gill and together they continued collecting. During the close of their sojourn they took a trip to the island of Jambele, off Puerto Bolivar, primarily to collect sea birds. Owing to the fact that the wind died down prematurely, they did not reach the island until an hour after sunset and were obliged to carry everything to shore, wading through water up to their waists. In this way they conveyed from shipboard their ten boxes and then, with the idea of placing them out of reach of the tide, carried them inland a quarter of a mile.

Jambele is a low-lying island, fringed with mangroves, intersected with tidal channels, and muddy in the extreme. To protect their possessions and to secure a dry foundation for their tent, the two collectors erected a platform of drift wood. This amphibious existence, which Messrs. Tate and Gill endured for several days, proves as attractive to sea birds as it is uninviting to man. Large numbers of these birds congregate at the island. A few land birds were also observed. Although few mammals were in evidence, one or two species of lizards were common on drift wood.

AMPHIBIANS

FOR over half a year a pair of *Ascaphus*, North America's only discoglossid frog, have

A "tailed" frog that frequents icy streams at high altitudes in the Olympic Mountains

lived in a special terrarium in the department of herpetology, American Museum. This species, perhaps the most primitive batrachian in the world, is found only at high altitudes among the Olympics and certain other western mountains. It frequents "dashing streams, snow-fed and spring-fed, seldom more than a foot or so wide and a few inches deep." An expedition sent out during 1920 by the University of Michigan reports that:

"Collecting in these creeks was an arduous task; they were very swift, with many falls and miniature rapids, filled with rocks, with great tangles of devil's club and fallen trees along their banks, and the water was extraordinarily cold, usually under 40° even on the warmest days.

"It was under the rocks in these little creeks that *Ascaphus* lived. . . .

"A low temperature and cold water are evidently necessary for the welfare of the species, for they died very quickly when placed in the sunlight. By putting fresh ice water on them at short intervals we were able to bring two, collected August 8, to Michigan alive. They lived in an ice box until September 11, when they were preserved. They refused to eat in captivity."

The live pair in the Museum are the only survivors of a large series of *Ascaphus* secured in August of last year from the Olympic Mountains. All of the frogs in the shipment were kept alive during transit in a device permitting ice water to drip on them continuously. In a similar device a number of specimens were retained alive in the laboratory while suitable studies were being made of them for exhibition purposes. The two specimens mentioned have maintained good health since their arrival last August although it has been necessary to feed them forcibly.

Ascaphus shows in its organization its basal position among the frogs and toads. It is unique among these in possessing in the tailless adult two "tail-wagging" muscles homologous to similar muscles in the salamander's tail. The so-called "tail" shown in the picture of the male *Ascaphus*, reproduced herewith, is a specialized cloacal structure having no relation to the vertebral column or the tail muscles just referred to. A series of morphological studies on *Ascaphus* have been commenced by the department of herpetology. The first contribution will appear soon in the *Bulletin*.

FISH

The exhibit of deep-sea fish, including several that are luminous, is now undergoing an overhauling but will in the near future be reinstalled on the second floor of the American Museum. These fish are arranged in a dark compartment, where the absence of light represents an approximation to the conditions prevailing in the sunless depths of the sea in which the life of these fish is spent. Under these conditions the luminescent organs of the fish, represented in the exhibit by tiny, electrically lighted surfaces, show clearly and convey an impression of the appearance of these fish under natural conditions. Intermittently, however, the compartment containing this exhibit is lighted completely so that the visitor may view the fish in detail, their peculiar conformation revealed and not merely obscurely outlined by the dim lumination supplied by their own light organs.

PUBLIC EDUCATION

"Teachers' Day," January 20, the faculty and members of the graduating class of the New York Training School for Teachers were the guests of the American Museum. They assembled at 2 o'clock in the auditorium, where President Henry Fairfield Osborn delivered an address of welcome and impressed upon the visitors the importance, as well as the opportunities, of the teaching profession. Mr. George H. Sherwood, curator of the department of public education, presented a short history of the Museum and specified the ways in which the Museum is prepared to coöperate with the schools. To illustrate how Museum slides may be used in teaching, he then gave a specimen talk on glaciers, with special reference to the accompanying slides. Dr. G. Clyde Fisher, associate curator of the department, demonstrated the potentialities of the Museum's series of moving pictures by delivering a talk, with film accompaniment, on "The Why of a Volcano." In furtherance of the same purpose, Mrs. Ruth Crosby Noble, assistant curator of the department, gave an explanatory talk while presenting a reel showing how the various exhibits of the American Museum are prepared, involving glass-blowing (illustrated by the model of *Synura*, on p. 90 of this issue), the reassembling of the bones of extinct animals for the palæontological exhibits, and other activities of the Museum's department of preparation.

The guests were then divided into groups and conducted by members of the Museum's staff through those exhibition halls of the Museum that are of greatest interest in connection with elementary school teaching and through the offices of the department of education, where they familiarized themselves with the routine to be pursued in obtaining Museum material for classroom use. At 4 o'clock the groups were reassembled in the hall of the Age of Man, where tea was served. Abundant evidence was given the prospective teachers that large as is the Museum, it is an approachable institution, faithful to its triple ideal of service—for the people, for education, for science.

PUBLIC HEALTH

THE collection of living bacteria, which under the able supervision of Prof. C.-E. A. Winslow has been so interesting and valuable a feature of the department of public health, American Museum, is being transferred to Washington, where it will be maintained by the Society of American Bacteriologists, an organization peculiarly fitted to take over the custodianship.

This collection has been built up to a total of 655 different organisms; it includes nearly every well-defined type of bacteria now known; it is the only collection of its kind in this country. The opportunity for public service which it offers can scarcely be overestimated. It was the policy of the Museum, not only to maintain the cultures in good condition, but to send subcultures, free of charge, to properly qualified workers in the field of biology. Since the collection was established more than 26,000 cultures have been made available in this way and more than 700 different institutions have been served. For the most part the cultures have been distributed among institutions in this country, but more distant points in England, South Africa, South America, and Japan have also had their requirements satisfied.

REMOVED as we are by 3000 miles or more from the suffering into which Europe has been plunged in these days of food scarcity, depreciated currency, bad transportation facilities, and political uncertainty, it is not easy to realize the conditions obtaining in some of the more afflicted centers of the Continent, nor to measure the help that American dollars, expended under the wise supervision of the American Relief Administration (Herbert Hoover, Chairman), have been to impoverished populations faced with starvation.

An exhibition setting forth the work of that Administration in feeding the children of Vienna, and including charts, diagrams, and other material illustrative of a system of nutrition established under the direction of Dr. Clemens Pirquet, was held in the hall of forestry of the American Museum during the first two weeks of January. One of the features of the exhibition was a fine series of illuminated and decorated messages and resolutions of thanks coming from many public bodies and schools in Austria. Children participated in the ornamenting of these testimonials, thus showing their appreciation of the help given them.

BIRDS

REFERRING to the appreciation of Dr. Joel Asaph Allen which President Henry Fairfield Osborn wrote for the issue of NATURAL HISTORY for September-October, 1921, Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology of the University of California, writes:

"It is a very just appreciation of a man whose great influence, I wish to point out, did not stop within the walls of the American Museum, nor within the confines of the Atlantic states.

"Of all the eastern ornithologists active during the past thirty-five years I believe that Dr. Allen wielded the greatest influence in the field of serious scientific ornithology out here on the Pacific Coast. It was through the columns of *The Auk*, especially in the review department of that journal, that Dr. Allen exercised this influence. I think others of the younger bird students here in the West would agree with me that our conceptions in systematic zoölogy and geographical distribution were molded more importantly by reason of Dr. Allen's sane criticisms and comments in his various reviews than through what we read in other articles and in books covering the same ground. I know that this was true in my own case."

MR. JAMES P. CHAPIN, assistant curator of African birds, has recently returned to the American Museum after an absence of several months in Europe. Mr. Chapin has in preparation a report on the birds of the Belgian Congo, represented in the collections of the Museum by no less than 6500 specimens. This paper will appear in the *Bulletin* of the American Museum. One of Mr. Chapin's objects in visiting Europe was to study, for purposes of comparison, the collections of birds of the Congo and adjacent regions in the museums of the Continent and of England. Everywhere he received a cordial welcome, as well as every facility for study, and was invited to attend meetings of both the British

This substantial ship has been acquired by the Whitney South Sea Expedition and will make possible even greater accomplishments than those that the expedition already has to its credit

Ornithologists' Club and the German Ornithologische Gesellschaft. There has been considerable progress in Congo ornithology since the publication, nearly two decades ago, of Dr. Anton Reichenow's notable work on the birds of Africa (*Die Vögel Afrikas*). Mr. Chapin's prospective publication, based on field work in the Congo extending over five and one half years and supplemented by intensive study of the birds collected, will mark an important forward step in the knowledge of this varied tropical fauna.

The acquisition of the "France" by the Committee of the Whitney South Sea Expedition, augurs well for the rapid expansion of the American Museum's investigations in Polynesia. During the first year's work, the purchase of several other schooners had been considered, but each time the matter was deferred until Mr. Rollo H. Beck, in charge of the field work, felt that he had found a vessel which suited all the requirements for collecting among the half-charted archipelagos of the southern Pacific.

The "France" is a schooner of 75 tons, with an auxiliary 60-horse-power engine. She was built at Tahiti about three years ago, and is, of course, of French registry. The French authorities in Polynesia, with characteristic courtesy, have waived the usual requirement of partial French ownership and have permitted the Museum to navigate the vessel under the tricolor and with a partly native crew.

About February 1, Mr. Beck sailed southward from the Society Islands in the "France" in order to avoid the hurricane season of the trade-wind belt. He hoped on this expedition to go as far eastward as Ducie and the Pitcairn Islands before returning to Tahiti.

Recent shipments from the field workers of the expedition include important collections of plants and reptiles, and several hundred birds from the Marquesas Islands and various islands of the Paumotu group, together with more than 2000 pages of manuscript notes written in the field by Mr. Quayle.

INSECTS

Among the beautiful things that meet the eye of a European who crosses the Atlantic are, and doubtless have been since the earliest voyages, the scintillating fireflies of summer. Though found from Canada southward, they become more noticeable in the West Indies because the common species are larger, more brilliant, and emit their light during a greater part of the year. The American Museum's expeditions during recent years have visited many West Indian islands, and hundreds of fireflies, representing many new species as well as nearly all that were previously known, have been among the specimens thus added to the Museum's collections. It has been a long task to compare these specimens with others obtained from England, France, and elsewhere, and determine which were new; the result, however, shows that of one hundred eighteen species now known, thirty-eight have been discovered through expeditions and studies conducted by the American Museum. The greatest interest really attaches to the extraordinary little creature found in the mountains of Porto Rico, christened *Leptolycus heterocornis*, the characters of which revealed not only a new species but a new genus and a new tribe. The minute studies with the microscope by Mr. A. J. Mutchler, assistant curator of the department of entomology, also disclosed in specimens from the little island of Montserrat morphological characters heretofore unknown in insects, the use of which still remains a mystery. "The Lycidæ, Lampyridæ, and Cantharidæ (Telephoridæ) of the West Indies" by Charles W. Leng and Andrew J. Mutchler is the title under which the results of these studies on the beetles commonly known as fireflies and some allied beetles which do not emit light, will appear in an American Museum *Bulletin*.

In delivering his address as president of the American Association for the Advancement of Science at the annual gathering in Toronto, Dr. L. O. Howard, Chief of the Bureau of Entomology, laid emphasis on the rôle of the insect as the strongest rival of man on this planet and on the need of a trained army of biologists—thousands of them—to wage successful warfare against the myriads of these tiny combatants that rob man of his food supply or, as disease carriers, threaten his life. Many of the most deadly instruments of destruction that man used in the recent World War have already been turned upon the insect hordes. Army flame throwers have been used against the swarms of locusts in the south of France; certain of the war gasses have been tried out as destroyers of insects; the aëroplane has been used for reconnaissance in connection with the pink bollworm along the Rio Grande, for locating beetle-infested timber in the forests of the Northwest, and even for insecticidal dusting of dense tree growths in Ohio.

Happily for man there is internecine strife in the insect world as well as in the human. Said a distinguished physicist recently to Dr. Howard: "If they would quit fighting among themselves, they would overwhelm the whole vertebrate series." Those insects that fight injurious species are the allies of man and in utilizing them in threatened areas, man finds one of his best weapons of defense. Dr. Howard, in closing, quoted a striking passage from Maeterlinck:

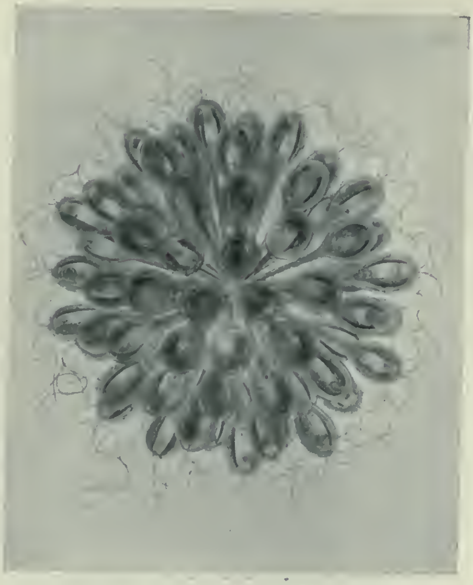
"The insect does not belong to our world. The other animals, even the plants, in spite of their mute existence and the great secrets which they nourish, do not seem wholly strangers to us. In spite of all, we feel with them a certain sense of terrestrial fraternity. They surprise us, even make us marvel, but they fail to overthrow our basic concepts. The insect, on the other hand, brings with him something that does not seem to belong to the customs, the morale, the psychology of our globe. One would say that it comes from another planet more monstrous, more energetic, more insensate, more atrocious, more infernal than ours. . . . It seizes upon life with an authority and a fecundity which nothing equals here below; we can not grasp the idea that it is a thought of that Nature of which we flatter ourselves that we are the favorite children. . . . There is, without doubt, with this amazement and this incomprehension, an I know not what instinctive and profound inquietude inspired by these creatures, so incomparably better armed, better equipped than ourselves, these compressions of energy and activity which are our most mysterious enemies, our rivals in these latter hours, and perhaps our successors."

MAMMALS

A consummate achievement in the art of taxidermy as perfected by Mr. Carl E. Akeley is the African elephant group recently placed on exhibition on the second floor, east wing, of the American Museum. It represents the culmination of eleven years devoted by Mr. Akeley to its preparation, in the course of which time he invented an entirely new method of mounting, which is exemplified in this group. The group consists of a young elephant, flanked on one side by a female and on the other by a large male with ears spread wide and trunk extended Covering the rear is another bull elephant with ears similarly spread. The female was secured especially for this group by Colonel Roosevelt during his African expedition of 1909 and was shot while charging. The little one was shot by Mr. Kermit Roosevelt south of Mt. Elgon. The two male elephants were taken by Mr. Akeley near Mt. Kenia earlier in the same year. This splendid group will ultimately occupy the center of the projected African Hall, which will form part of a section of the American Museum to be erected as a memorial to Theodore Roosevelt. Plans for this hall, as well as for the groups illustrative of the animal life of Africa, have been prepared by Mr. Akeley.

An invitation has been extended to the American Society of Mammalogists to use the American Museum for their annual meeting. It is comtemplated to hold this meeting early in May, if possible at the time when the New York Zoölogical Society formally opens its hall of heads and horns.

The issue of Natural History for November-December, 1921, contained a picture of John



A colony of the microscopic organism, *Synura*, that recently imparted such a disagreeable flavor to the drinking water of New York City

Gorilla, which, not only because of the popular interest in the subject but in equal measure because of the convincing and natural manner in which the ape is mounted, was given an entire page. Through an unfortunate oversight the caption connected with the picture failed to give credit to the artist who planned and executed this piece of work. It was Mr. Frederick Blaschke, whose large groups, including the Pigmy camp in the Congo forest, the red ground monkeys, the horse-tailed monkeys, and the European boar, are well known to all who have visited the Museum.

LOWER INVERTEBRATES

On account of the popular interest in *Synura*, the protozoan animalcule which has recently been spoiling the taste and odor of the drinking water of New York City, a glass model representing a colony of this organism, prepared by the department of lower invertebrates, was placed on special exhibition in the foyer of the American Museum in January and has attracted considerable attention. This is evidenced by the fact that on Sunday, January 15, when *Synura* was at the zenith of its effectiveness, 15,000 persons visited the Museum as compared with the average Sunday attendance of 5000. A colony of *Synura*, when fully grown, is composed of about fifty individuals, which radiate from a common center by slender prolongations of protoplasm, and measures about $\frac{1}{250}$ of an inch in diameter. It gives off an oily substance which spreads rapidly through the water, causing the fishy or cucumber-like taste that has proved so objectionable. A small quantity of such oil will affect a considerable quantity of water. Fortunately it is harmless. *Synura* is usually present in drinking water, but cannot be detected except at certain times when it multiplies with great rapidity. Its power of reproduction is well illustrated by the fact that the colony of fifty individuals may break up and each member may then become the starting point of a new colony of fifty or more individuals.

MAN

Archæological finds of no little value are reported under recent date by Mr. Earl H. Morris, who is engaged in the excavation of the Aztec Ruin, New Mexico:

"A point of interest has just turned up here. I found a skeleton sticking out of the bank of Nelson's test pit in the southeast refuse mound, and with it two fine pieces of Chaco ware. Today I found another grave on the opposite side of the pit, also accompanied by the older pottery. It has always been very much of a puzzle where the Chaco people of this place put their dead, as only one skeleton identifiable as of this age has been found previous to these two. It now looks as if there may be quite a few in the southeast refuse mound. Of course, it has been pretty well prospected, but in the untouched parts there is room for scores of graves. I hope they prove to be there."

To the February issue of the *National Geographic Magazine* Mr. Sylvanus Griswold Morley, of the Carnegie Institution of Washington, has contributed under the title "The Foremost Intellectual Achievement of Ancient America" an excellent popular presentation of a very difficult subject. The men who have made the most important recent contributions to our knowledge of ancient civilization in Central America are the writer in question and Doctor Herbert J. Spinden, formerly associate curator in the department of anthropology, American Museum, and now of the Peabody Museum, Harvard Unversity. Mr. Morley gave his chief attention to the translation of inscriptions on monuments and the discovery of new inscriptions. In the latter he has been particularly successful and thus has added greatly to our knowledge of dated inscriptions and has consequently recovered for us a great deal of the early history of the Maya.

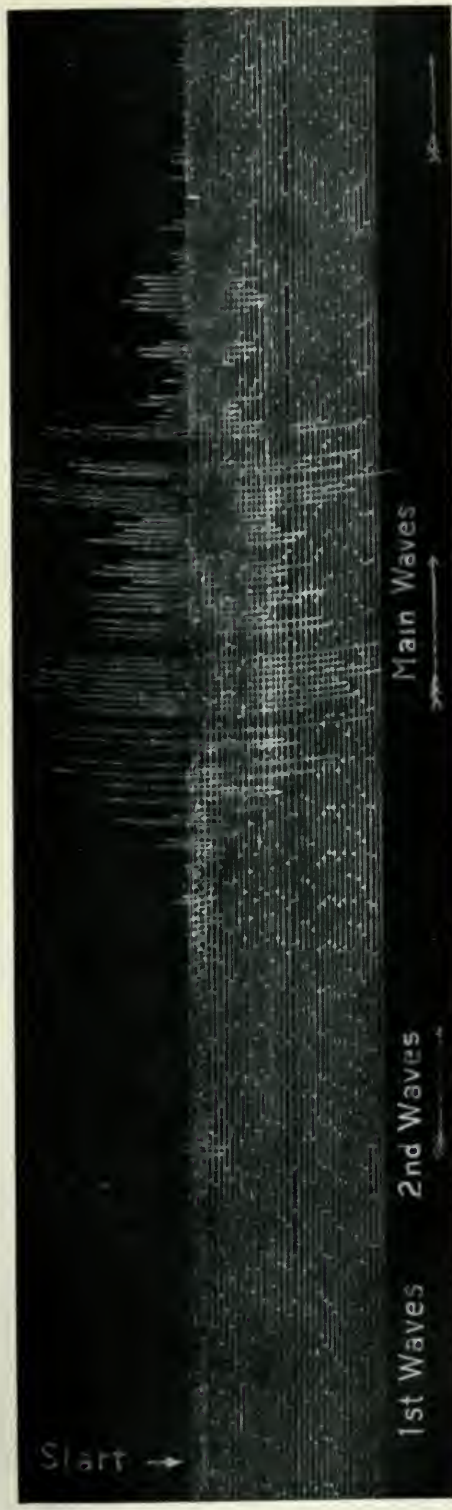
Doctor Spinden gave his chief attention to the development of Maya art, being able to establish broad chronological differences in art objects from the Maya and thus laying down a general chronology for the whole of Central America. This he was later able to supplement by conducting explorations for the American Museum, with the result that a general working scheme for the chronology of New World culture has been established.

THE EARTHQUAKE OF JANUARY 31

Although on an average there are three earthquakes a day in different parts of the globe, it is only when an earthquake of cataclysmic proportions occurs that the general public takes cognizance of it. On January 31 of this year occurred an earthquake which, had it affected a populated section of the world, would have created as much havoc doubtless as did the great San Francisco earthquake of 1906. It was as violent as that disturbance but devoid of harm because it occurred on the floor of the ocean, in all probability about 600 miles northwest of San Francisco. It was caused, no doubt, by earth shiftings along the fault plane known as the Andreas rift, a rift that traverses the region of which San Francisco is a part, extends thence along the California coast, and links up with the site of the disturbance of January 31 by pursuing a northwest course. Thus the San Francisco disaster of 1906 and the earthquake of January 31, 1922, are related phenomena.

On the morning when the earthquake occurred an interested group gathered about the Mainka seismograph in the American Museum and watched attentively the violent fluctuations of the needle that indicated a disturbance of very great intensity and possibly one involving dire calamity for many human beings. While the earthquake was in progress, there was opportunity for speculation as to the place of its occurrence, for until data can be secured from two other widely separated recording stations, making triangulation possible, the location of a particular quake cannot be determined. The seismograph record, reproduced herewith, of the earthquake shows the two preliminary and the main waves. The more remote the site of the recording station from the scene of the disturbance, the greater is the distance on the record between the arrival of the first preliminary, the second preliminary, and the main waves. These facts are helpful to the observer in computing the distance intervening between the station and the scene of the quake.

It is to Mr. Emerson McMillin, a former president of the New York Academy of Sciences, that the public is indebted for the purchase and installation in the American Museum of the fine seismograph there in operation. On the day that the earthquake occurred President Henry Fairfield Osborn telegraphed to Mr. McMillin and received from him this cordial response: "For your thoughtfulness I feel deeply grateful. For those who have given their time and means to keep the seismograph in working order, I also feel grateful. I am glad to know that New York will occasionally take an interest in its own scientific facilities and does not have to depend on Cleveland, Georgetown, or some other small but enterprising city."



The record, from the seismograph in the American Museum, of the earthquake of January 31

BUTLER'S PAINTING OF THE NORTHERN LIGHTS

Mr. Howard Russell Butler has on several occasions painted Bald Head Cliff near Ogunquit, Maine. One of these pictures, showing the scene by moonlight, won the Carnegie Prize in 1916. In August, 1919, the artist was revisiting the region and under the spell of its old-time appeal to him, decided to make one more nocturnal painting of the cliff. He set to work on his sketch, favored by a cloudless sky in which the "Queen of the Heavens" shone in full splendor. Mr. Butler had completed his foreground, and was resting, entranced with the scene, his sketch board and colors at hand, when the first light of an aurora borealis appeared. Seized by an inspiration, the artist immediately extended his sky, changing his picture from a horizontal to a vertical one, and had the good fortune of transferring to canvas a record of one of the most magnificent auroras that have ever been seen on the coast of Maine, where brilliant manifestations of the northern lights are frequent.

The result is the beautiful painting now on exhibition at the American Museum. A black and white reproduction of this picture appeared in Natural History for March-April, 1921 (p. 205), but the accompanying reproduction in color gives a better idea of the phantasmal beauty and sublimity of this phenomenon.

FOSSIL VERTEBRATES

During the last few years the University of Toronto has secured a large collection of Cretaceous dinosaurs from the Red Deer River in Alberta and has under way what promises to be a very fine exhibit. Among the first specimens secured was a nearly complete skeleton of the *Kritosaurus*, or hook-nosed duck-bill dinosaur, a form first discovered in New Mexico, later in Canada. This skeleton was the subject of a very excellent monograph by W. A. Parks, professor of geology in the university, and is now handsomely installed in its great geological museum. Another fine skeleton found last summer is reported by Professor Parks to be a new genus related to the *Corythosaurus*, or helmet dinosaur, of which two fine skeletons are in the exhibit of the American Museum. All these dinosaurs of the duck-bill group are huge, bipedal reptiles, with long legs, hoofs on the feet, a flattened, horny beak suggestive of that of the ducks and geese, and cheek teeth fitted like those of modern horses or ruminants to grind the food. Finally, they had a powerful, flattened tail, resembling in this respect the crocodiles or other swimming reptiles. These facts prove that they were harmless vegetarians, admirably adapted to wading and swimming, and finding in their amphibious habits a refuge from the huge carnivorous dinosaurs that terrorized the land, while their habitat of fresh-water bayous and rivers protected them from attack by the fierce mosasaurs (gigantic marine lizards) that infested the open sea. Nevertheless, these duck-bill dinosaurs did on occasion venture out into the ocean, for their remains are occasionally found in true marine formations deposited at a distance from the land. No bones of any of the other kinds of dinosaurs have been found in the ocean sediments of the Cretaceous period.

The University of Alberta at Edmonton also has entered the dinosaur field during the past summer. It engaged Mr. George M. Sternberg, one of the best experts in dinosaur collecting, to take charge of an expedition to the Red Deer River. Mr. Sternberg secured a fine collection, including skeletons of the carnivorous and duck-bill dinosaurs, and a partial skeleton of a rare armored dinosaur, *Stegoceras*, hitherto known only from a fragment of the skull. With this auspicious beginning, the geological department of the university, under the direction of Professor John A. Allan, intends to continue and expand the dinosaur work as a leading feature of Alberta geology.

EMILE CARTAILHAC

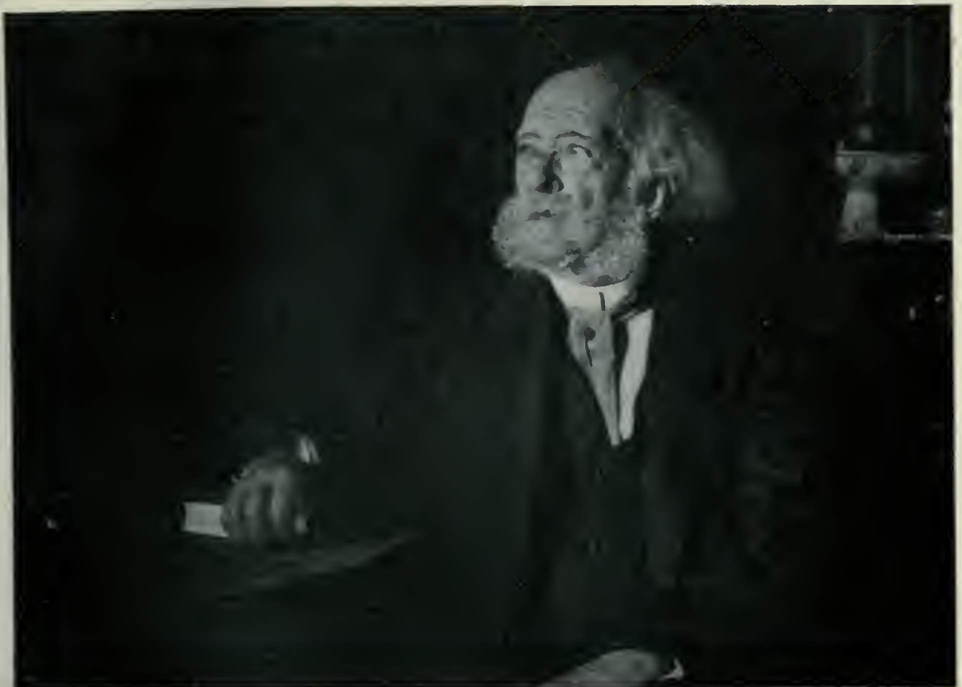
Professor Emile Cartailhac, veteran archæologist of France and leader of the modern school, passed away at Geneva on November 25.

Readers of Professor Henry Fairfield Osborn's *Men of the Old Stone Age* will recall the photograph of Professor Cartailhac leading the way to the entrance of one of the caverns. The photograph on p. 93 gives an idea of his venerable figure but conveys little conception of his remarkable activity. Professor at the University of Toulouse for the past forty years, he found time not only to conduct excavations in all the archæological regions of southern France but also to contribute a series of splendid volumes and writings to the Memoirs of the Institut de Paléontologie Humaine and of shorter papers to the leading French journals of anthropology. One of his most popular works is *La France Prehistorique d'après les Sepultures et les Monuments*. Among his most learned contributions is his volume *Les Grottes de Grimaldi—Archéologie*. The Museum of Toulouse contains a delightfully arranged historic collection, the work of Professor Cartailhac. In 1913 it was Professor Osborn's great privilege to have Professor Cartailhac conduct him through the caverns of the Pyrenees region; in those most difficult to traverse as well as in those more easy of access he was alert and sure-footed and put to shame his less agile American companions. On the occasion of the discovery of the famous caverns near the residence of the Comte de Bégouen, Professor Cartailhac was called by telephone and arrived by the next train ready to take any risks to be the first to see the riches of the Tuc d'Audoubert and of Les Trois Frères. To express his

Courtesy of University Society Inc.

NORTHERN LIGHTS, MAINE COAST, AUGUST, 1919

From a painting by Howard Russell Butler



Emile Cartailhac, veteran archæologist of France, whose death occurred recently

appreciation. Professor Osborn dedicated his *Men of the Old Stone Age* to his "distinguished guides through the Upper Palæolithic caverns of the Pyrenees, Dordogne, and the Cantabrian mountains of Spain," of whom Emile Cartailhac was the first.

ALESSANDRO FABBRI

Alessandro Fabbri, research associate in comparative physiology in the American Museum, died of pneumonia on February 6. Mr. Fabbri was a many-sided man, one who, by nature a scholar, gave his energies to the pursuit of things of worth. Although a lover of music, art, and literature, it is through his scientific experiments that Mr. Fabbri will be remembered best —experiments which brought him into touch not only with the American Museum but also with the Rockefeller Institute. He was extraordinarily adept in micro-cinema photography. Some of his motion pictures reveal the behavior of organisms so minute that a drop of water suffices for the theater of their activities. In one of his films barnacles are shown, their fine, feathery appendages in motion, grasping for the food that may be floating within their reach. Another motion picture he secured is that of the embryo chick in the several stages of its development. In this film the beating of the chick's heart may be seen and, more marvelous still, the circulation of its blood even to the inclusion of the corpuscles.

Of all his micro-cinema photography, however, no single achievement was as great or of as far-reaching service as the series of pictures he took of living, growing tissue, thereby supplementing in an important way the research work that Dr. Alexis Carrel of the Rockefeller Institute has been doing in connection with such tissue. The loss that science has suffered in the death of Mr. Fabbri may be measured to some extent by the fact that it was his hope, had he lived, to devise means for obtaining a motion picture of the growth of a cancerous cell and its behavior during the application of radium.

Another interest of Mr. Fabbri was wireless telegraphy. The radio station at Otter Cliffs, Bar Harbor, Maine, which Mr. Fabbri erected, was used under his direction during the war as a link in the coastal patrol system. The efficiency of this station gradually won it a place of pre-eminence and before the close of the war and continuing throughout the negotiations for peace, the most important messages of the Government were transmitted through this station, no less than 110 operators being required for the work involved. Under Mr. Fabbri a new and much more effective system of receiving was developed, which, in justice to its originator, the Government wanted to call the Fabbri System, but with characteristic modesty Mr. Fabbri declined this honor, which he felt should be shared with those who had carried out his idea.

That the Government did not fail, however,

ALESSANDRO FABBRI

to take cognizance of the invaluable aid given by Mr. Fabbri is indicated by the citation accompanying the conferring upon him of the Navy Cross:

THE SECRETARY OF THE NAVY,
WASHINGTON, 11 November, 1920.

SIR:

The President of the United States takes pleasure in presenting the Navy Cross to

Lieutenant Alessandro Fabbri

for services during the World War as set forth in the following:

Citation:

For exceptionally meritorious service in a duty of great responsibility in the development of the radio receiving station at Otter Cliffs, Maine, and the small sending station at Sea Wall. Under Lieutenant Fabbri's direction, the station was developed from a small amateur experimental station, until at the end of the War, it was the most important and the most efficient station in the world.

For the President,
JOSEPHUS DANIELS,
Secretary of the Navy.

Early in 1910 Mr. Fabbri conducted a marine expedition in the interests of the American Museum, using for the purpose a boat, the "Tecla," which he equipped especially for the collecting of fish. At Miami Mr. John T. Nichols, of the scientific staff of the Museum, joined the expedition, which included, in addition to Mr. Fabbri and his brother Ernesto, an adequate force of men. For several weeks they cruised from Miami to Key West and thence up the west coast of Florida, obtaining a fine series of West Indian fish for the study collections of the Museum—a series which, consisting of about 200 species, several of them new to science, has been of constant use since.

CONSERVATION

MR. H. E. ANTHONY, associate curator of mammals of the Western Hemisphere, American Museum, attended the annual meeting of the American Game Protective Association held at the Waldorf Astoria, December 12–13. He represented President Henry Fairfield Osborn and the American Museum at these meetings. The session was well attended by men from all over the United States and Canada, and among those present were many whose names have figured prominently in movements for the protection of wild animal life. Many state game commissioners and wardens presented outlines and reports of progress in according such protection, and the general sentiment of the congress appeared to be strongly in favor of the segregation of large areas to serve as game refuges and as public hunting domains when properly restricted. An idea which seems to be widely rooted and which would appear to be in need of some modification is that all predatory mammals must be greatly reduced in numbers, the reduction in some cases being tantamount to extermination. This condition is desired ostensibly to protect wild life, and, to an even greater extent, domestic stock. The consequences of any such deliberate upsetting of natural balances are so apparent, whether viewed from the standpoint of practical economy or from an æsthetic love of nature, that they may well bring to question the advisability of such measures. An area where all coyotes, wolves, bobcats, etc., have been extirpated might be a land of bounteous flocks to the sheep man, and yet be so overrun by jack rabbits and ground squirrels, deprived of their natural check, that it would be worthless to the ranch man.

MR. EDWARD L. PARTRIDGE has accepted the invitation of President Henry Fairfield Osborn of the American Museum and the New York Zoological Society to represent those institutions at the second Conference on State Parks that is to be held May 22–25 at Bear Mountain Inn, Palisades Interstate Park. The first Conference, which took place in Des Moines in January, 1921, gave a powerful impetus to the movement. New parks have been created and desired legislation has been enacted. With past accomplishments to stimulate it to new endeavors, the prospective Conference will take up its work, hopeful that in the not distant future all of the states of the Union may participate in the establishment of parks and that the slogan of "a state park every hundred miles from Maine to California" may become an actuality. The governor of each state is being urged to appoint an officia delegate, or delegates, to the Conference and in addition various associations, interested either directly or indirectly in the state park idea, are invited to send their own representatives.

The place of gathering chosen for the Conference will afford the delegates an opportunity, in the intervals given to recreation, of seeing the development that has taken place in the Palisades Interstate Park. Among the excursions planned is a motor ride from the Bear Mountain Inn across the Hudson to Lake Kensico and from there down the Bronx River Parkway to the New York Zoological Park.

CHARLES BASKERVILLE

IN THE death of Dr. Charles Baskerville, on January 28, 1922, the science of mineralogy lost a valued contributor and the science of chemistry a talented, brilliant, and indefatigable worker, one who was keen in research and also a great instructor. In the University of North Carolina (1891–1904) and in the College of the City of New York from 1904 up to the time of his death, he gave constant proof of his devotion to science.

He was versatile, enterprising, industrious, and of a splendid physique. He was a good speaker, which made him a good lecturer, and he presented his papers with remarkable terseness. As a chemist, he had an unusually broad vision. In addition to his work on anæsthesia, he treated of chemistry as applied to occupational diseases, and did most important work in the study of the rare earths. But of special interest to the American Museum were his researches in phosphorescence and radio-activity, for these two fields of investigation brought Dr. Baskerville into immediate contact with that institution.

About 1903, a variety of spodumene was identified as new by the writer, and it was his intention to name it after J. Pierpont Morgan. It was, however, impossible to get in touch with Mr. Morgan at that time, and Dr. Baskerville then named this mineral after the writer.[1] It responded to the ultra-violet rays, the Roentgen rays, radium, polonium, and actinium.

At that time an extended investigation of certain optical properties of the gem-minerals in the American Museum was in progress. To have moved all these minerals, 15,000 in number, to a dark room would have been a laborious task and would have meant disarrangement of this magnificent collection; furthermore, there was the danger of breaking and abrading many of the exquisite and delicate crystals, which are the feature of the collection. Therefore, an apparatus was devised on a moving stand, and the various substances were brought in direct contact with the radiations. A thorough investigation was made in the latter part of July and in August, Dr. Baskerville and the writer devoting more than twenty nights during these months to the task.

CHARLES BASKERVILLE

Dr. Baskerville, not only by his own researches but also and especially by developing and equipping what was perhaps the best series of chemical laboratories in the United States, and by organizing a department which has given tuition to hundreds of young men preparing themselves for service in this science, made his lasting contribution, though his studies and researches and teachings here are over.—GEORGE F. KUNZ.

[1] *Am. Jour. Sci.* Vol. XVI, 1903, p. 265; Baskerville, *Science*, Vol. XVIII, Sept. 4, 1903, pp. 303-304.

TROPICAL RESEARCH STATION

A FINE series of water-color pictures of animals painted from nature by Miss Isabelle Cooper of the Tropical Research Station of the New York Zoological Society, at Kartabo, British Guiana, were recently on exhibition at the American Museum. Many of these pictures have figured as colored lantern slides in the lectures of Mr. William Beebe, the director of the Station. They include a variety of subjects: reptiles, striped, spotted, or with scroll-like markings, spiny backed as well as smooth; insects of grotesque shape, some with leaflike appendages on the third pair of legs; fishes of brilliant hue and birds of fine plumage, as well as several interesting studies of bats. Not only are the creatures represented in their entirety but in many cases enlargements have been made of special parts, such as the head and forequarters. The eyes of a number of reptiles, brilliant pools of variegated color, are depicted in this way and serve as records of the appearance of the organ in life, the pigmentation being altered in death. One picture shows a parasitic wasp alighting on a caterpillar. The victim is writhing in its vain efforts to throw off the tiny flier, which is presumably about to thrust its sting into the caterpillar and deposit its eggs.

In addition to the pictures arranged about the walls, the room devoted to this exhibit contained two cases. In one of these were gathered some of the larger publications that have resulted from the researches of the Station; in the other case, sample lithographic reproductions of the paintings shown. The New York Zoological Society will publish these reproductions from time to time in portfolios of one hundred, together with the life histories of the animals depicted.

INSTITUTE FOR RESEARCH IN TROPICAL AMERICA

At a recent meeting of the institutional representatives of the Institute for Research in Tropical America, Dr. A. S. Hitchcock of Washington was elected chairman of the Executive Committee and Dr. Alexander G. Ruthven of the University of Michigan, secretary and treasurer. Dr. Henry E. Crampton, until recently honorary curator of lower invertebrates in the American Museum, was elected vice chairman. He is succeeded in his functions as representative of the American Museum in the Institute for Research in Tropical America by Dr. Frank E. Chapman, curator of the department of birds.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Benefactors: Messrs. George F. Baker and Ogden Mills.

Associate Founders: Messrs. Charles Lanier and Harry Payne Whitney.

Associate Benefactor: Mr. John D. Rockefeller, Jr.

Patrons: Mrs. Clement Acton Griscom; Messrs. George F. Baker, Jr., George J. Baldwin, Charles L. Bernheimer, and Frank J. Myers.

Fellows: Mrs. Charles L. Bernheimer; the Honorable Recaredo Amengual; Messrs. Murray Guggenheim, S. R. Guggenheim, Dwight W. Morrow, and John T. Pratt.

Life Members: Mesdames E. H. Danforth, Lawrence L. Tweedy; the Misses Elizabeth Vernon Bronson, Isabel Rogers Edgar; Lieutenant Harry F. Guggenheim, U.S.N.; Messrs. Edgar B. Bronson, Jr., Barnum Brown, George Agnew Chamberlain, A. K. Haagner, T. W. Lamont, Mengo L. Morgenthau, H. Obermaier, Harper Silliman, Ludovic Soderstrom, and Irving K. Taylor.

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NATURAL HISTORY

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THE JOURNAL OF THE AMERICAN MUSEUM

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

MARCH–APRIL, 1922

[Published May, 1922]

VOLUME XXII, NUMBER 2

NATURAL HISTORY

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

Natural History *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

GETTING ACQUAINTED

By visiting the mountain goat group in the American Museum this little girl is acquiring knowledge about an animal that has been seen in its inaccessible native haunts by comparatively few individuals. Gladly would she push aside the protective barrier of glass that separates her from her shaggy friend

WHAT THE AMERICAN MUSEUM IS DOING FOR THE SCHOOL CHILDREN OF NEW YORK

BY

GEORGE H. SHERWOOD*

LONG before the advent of motion pictures, even long before the stereopticon and its forerunner, the magic lantern, made their appearance, museums were the great exponents of objective teaching. It is true that for many years they were passive or static agents of instruction, disseminating knowledge chiefly to the more or less casual visitor, and were less concerned with the imparting of information than with the preservation of records—scientific or historical. This viewpoint has passed away and the modern museum now stands as an aggessive force in education. This is particularly true of natural history museums.

Through improvements in the technique of preparation, through attractive and appealing labels, and through the development of the habitat group idea, which shows the interrelation and interdependence of all life, the exhibition halls of the up-to date natural history museum have become veritable magnets to which are drawn both young and old. The instruction thus imparted is, however, somewhat casual and it is rather through direct contact with school systems that museums have become entitled to consideration as important factors in education.

From its inception in 1869 the American Museum of Natural History has taken an active part in educational affairs. The incorporators of the institution had in mind close contact with the schools, and its first curator of education, Professor Albert S. Bickmore, may be regarded as the father of visual instruction. Throughout the period of his curatorship, 1881–1904, he was an enthusiastic believer in the teaching value of lantern slides and through his lectures to the teachers of the state his reputation became national. When he took hold of this work, the technique of making lantern slides was in its infancy and simple projection machines had not been developed. Professor Bickmore ransacked the corners of the earth for the best material. There was not a traveler of note who came to New York whom he did not seek out and ask for his negatives. He journeyed to remote lands himself, to obtain first-hand information, and in later years often sent out special photographers in order to secure the best results possible. One of the greatest contributions which the American Museum has made to visual education is this work of Professor Bickmore. Even today, notwithstanding the great advance in photography, the excellence of a "Bickmore slide" is seldom, if ever, surpassed.

During Professor Bickmore's curatorship the Museum's service to the schools consisted chiefly of instruction for teachers. In 1904 a new policy, namely, instruction for children, was inaugurated, which, under the presidency of Prof. Henry Fairfield Osborn, a lifelong student of educational methods, prevails at the present time. As New York City annually contributes generously to the maintenance of the Museum, it is proper that the Museum should give special attention to the needs of the schools of the city. Thus the methods of instruction which have been developed by the American Museum during the last eighteen years are designed to meet the conditions of the local school system. They are, however, based on such fundamental, pedagogical principles that they may be easily modified to apply to any other school system.

The school service of the American Museum of Natural History includes

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There are at present a total of 869 nature study collections, which the American Museum lends without charge to any public school in Greater New York. In 1921, 477 schools were regularly supplied, and the collections were studied by nearly 1,300,000 pupils

the circulation of nature study collections in the schools, the delivery of illustrated lectures for school children at the Museum and in the schools, the lending of lantern slides to teachers, guide service and exhibitions within the Museum, hall instruction for visiting classes, instruction for the blind, exhibitions in public libraries, and the preparation of aids for particular needs of teachers—for example, in art and domestic science classes and in training schools for teachers. These activities are carried on through the Museum's department of public education.

The program of school service adopted by the Museum has the hearty endorsement of the Board of Education, superintendents, and other school officials, but the conduct of the work is left entirely to the department of public education of the Museum, which is responsible for the relation with the schools. This action on the part of the school authorities has been an important factor in the success of the work, because it has simplified the service and brings the Museum's staff in direct contact with the principals and teachers, thereby leading to a better understanding of their needs.

The oldest feature of this service and the most extensive is the circulation of nature study collections. This work was begun in 1904. The collections are of small size, each being contained in a wooden carrying case, which is about the size of a large suit case. The material comprises representative specimens of mammals, birds, insects, lower invertebrates, minerals, woods, and public health charts and exhibits. The purpose of these collections is to place in the hands of teachers good nature material that is required for classroom instruction and at the same time give authoritative data in regard to it.

The general make-up of the various collections is similar. Take the "bluebird set" as an example. This collection consists of five birds—bluebird, phœbe, barn swallow, house wren, and chimney

Quick delivery of lantern slides and nature study collections is assured through the employment of three messengers and the maintenance of two automobiles and a motor cycle sidecar. Each messenger visits from twenty to forty schools a day. The motor cycle used in making these deliveries often travels one hundred miles in a day

swift. Incidentally this series has an added interest as it shows five birds the nesting habits of which have been modified by contact with man. Each bird is mounted on a separate pedestal and is easily removable from the carrying case. An individual label is attached to it, giving a few facts concerning it. The collection as a whole is accompanied by a manuscript, prepared in consultation with the curator of birds, describing the principal habits of these birds, their relation to each other, and especially to man. Reference is made to the local bird collection in the Museum, which is changed every month to correspond with the bird life of our city parks, and in conclusion a brief bibliography of popular books on the subject is offered as a suggestion for school reading. This scheme has been followed in the case of most of the collections, although some modification has been necessary in certain subjects.

Access to these collections has been made as simple as possible for teachers. Museum messengers deliver the collections in the desired sequence to any public school in Greater New York and call for them at the end of each loan period, that is, every three weeks. To make these deliveries the Museum employs three messengers and maintains two automobiles and a motor cycle side-

BIRDS THAT ARE OUR FRIENDS

This is a specimen of the contemplated new type circulating collection, in which the environment of a bird or a mammal is shown in addition to the creature itself. The label-holders are hinged to the back of the case and close over the ends, protecting the glass during transportation. The label at the left is general and gives reasons why birds are our friends. That on the right deals with the habits and use of the specific birds in the case, each bird being identified by a simple drawing instead of by title or number car, which not infrequently covers one hundred miles in a day. The entire cost of this service is borne by the Museum.

From time to time new collections are added to the series. The circulating food exhibit, which has been in use for about a year, is an example of a special exhibit to meet a particular need. The proper nourishment of children is an important and vital problem, especially in New York City. Calories and figures mean little or nothing to either parents or children. Both can understand relative food values if they have placed before them objects showing correct portions for a proper diet. To aid the domestic science teachers, the department of public education in conjunction with the Museum's department of public health, prepared an exhibit showing the proper daily food for a child. This exhibit consists of attractive wax models of the foods listed in the accompanying table. These wax models are neatly packed in a small carrying case and so arranged that they can be quickly assembled to show the proper food and right portion for the breakfast, luncheon, and dinner of a normal, healthy child. The food value of each portion is clearly indicated and the exhibit is further explained by a series of illustrated wall charts giving dietary facts and figures. A leaflet setting forth the fundamental principles of the diet accompanies each collection. This is practical visual education carried into the home, as well as the school, because this exhibit is often requested for parents' association meetings.

A contemplated addition to our circulating collections of wild life is a series of the habitat group type, which is intended to give more of the environment of a species than is possible in the case of the hand specimens of the earlier collections. One of these habitat groups, "Birds That Are Our Friends" has been completed and is now undergoing in the New York Training School for Teachers a practical test as to its instructional value. Several others are in preparation and still others projected.

These new collections, for which special cases have been designed, are intended mainly to supplement the earlier collections, not to replace them. As will be seen from the illustration on page 104 this kind of exhibit has a painted background suggestive of habitat. The case was modified from the type in use by the Field Museum of Natural History in its school work. At each end there is a hinged wing which, when open, serves as a label holder and when closed, protects the glass ends of the case. In the left wing is a general label giving some of the reasons why birds are useful to man. The label in the right wing deals with the habits and service of the individual birds of the exhibit. Another new feature is the identification of the bird in the exhibit by means of an outline drawing of the bird to scale on the label. In a modification of this type of label it is the intention to substitute for the outline drawing in some cases photographs from nature showing the bird in its actual habitat.

Each of the circulating collections bears an identification number and title. On the reverse side of the card, which is carried in an appropriate label holder on each cabinet, is a form for recording the itinerary of each collection, the number of pupils using it, and the signature

BREAKFAST	LUNCHEON	DINNER
Baked apple	Cream of tomato soup	Lamb stew
Oatmeal with milk	Whole wheat bread and butter	Potato
Two slices buttered toast	Stewed prunes	Spinach
Glass of milk	Cookies	Glass of milk
	Cup of cocoa	White bread and butter
		Rice pudding

"Indians of the Woodlands" is one of the collections lent to libraries. Such collections are placed in the children's rooms and stimulate the reading of good books. Libraries provided with collections by the American Museum—and fifteen libraries are at present availing themselves of this privilege—are visited by pupils from the schools of the neighborhood who, under the guidance of their teachers, study these exhibits. During 1921 more than 100,000 children and adults were instructed in this way

Public school teachers visiting the department of education, American Museum, to select slides for their classroom lectures. In 1921, no less than 182 schools were served, the number of loans were 3963 and more than 200,000 slides were circulated of the teacher furnishing the data. The extent of this branch of the Museum school service is indicated by the comparative statistics of the last four years presented in the accompanying table.

Another illustration showing restricted environment is the following. The class was reading a poem dealing with the "signs of spring,"—daffodils, frogs, etc. The children did not comprehend the meaning of the phrase. Finally the teacher asked how we know that spring is here. Johnny was the only one who raised a hand. "Well, Johnny, how do you know that spring is here?" "Because I saw them hanging the swinging doors on the saloons." Certainly the nature study collections from the Museum helped to give Johnny a new conception of spring.

	1918	1919	1920	1921
Number of collections in use	628	668	887	869
Number of schools in Greater New York supplied	419	385	448	477
Number of pupils studying collections	790,346	860,992	1,176,055	1,247,515

We learn from the teachers that not only have the collections proved their value in teaching facts about nature, but they have also been particularly useful in language work, especially with the foreign-born children. Perhaps their greater service, however, is giving these city children a glimpse at the great out-of-doors. The country dweller has very little conception of the limited horizon of thousands of these children in the congested parts of the city. Many of them never get more than a few blocks from the place where they were born. The school building is the limit of their travels. The dog, the cat, and the horse are the only animals they have ever seen. The vegetable market window or the flower-laden pushcart represent their knowledge of growing things. No wonder then that the little nature study exhibits from the Museum stimulate their imagination and broaden their outlook.

In one instance one of our bird collections was used as a basis for letter writing. It is evident that the teacher had suggested the general theme—a letter of thanks to the Museum for sending the beautiful birds, which were liked because of their pretty colors. The most suggestive and pathetic of the letters read something like this: "I thank you very much for sending to our school the beautiful birds. I think the robin is pretty because he has a red breast and the bluebird because of his blue coat, but the one I like best is the English sparrow because it is the only bird I have ever seen." What would this little girl think if she could make a trip to the real country!

For several years the loan by the Museum of nature study material for schoolroom use has been well supplemented by the special exhibits lent to public libraries of the city. In the study collections of the Museum are clothing, pottery, baskets, industrial models, dolls, implements of war, birds, animals, and many other types of specimens that can be used with success to illustrate books on travel, geography, nature study, history, art, and current events. From these, with the coöperation of the curators of the several departments, circulating loan exhibits are selected. By arrangement with the librarians, such exhibits are installed in the children's rooms of the libraries for varying periods. These exhibits are naturally more extensive than those of the schoolroom type. They are adequately labeled and in some cases illustrated with large mounted photographs.

The primary purpose of these exhibits is to stimulate the children to read good books. More often the collections form the basis of definite coöperation between the schools and the libraries. Children who are studying Mexico in the classroom are taken by their teachers to the

DR. G. CLYDE FISHER LECTURING TO HIGH SCHOOL STUDENTS IN THE AMERICAN MUSEUM library, where they examine the Mexican material loaned by the Museum and read books describing that country.

This coöperation with the libraries takes the Museum to the neighborhood. Oftentimes, moreover, these exhibits awaken the spirit of research, prompting both the child and his parents to visit the extensive collections at the Museum and then in turn to go back to the library for further reading.

Thus through the circulating nature study collections sent to the schools or through an exhibit in the library the school child receives his introduction to nature. Then comes the day when the teacher takes him and his mates to the Big Museum. Here the class is met by staff members who explain the wonders of each exhibition hall. Advanced classes, groups from the high schools and colleges, return again and again for observation and study. The well labeled exhibition hall becomes, therefore, a great silent teacher.

Annually upwards of 200 of the city schools and more than 100,000 school children come within the influence of the school lecture service of the Museum. This branch of the Museum's free nature education began in 1904 with a series of five lectures, illustrated with lantern slides, that was given in the auditorium of the Museum. Their success was immediate and their continuation strongly urged by the teachers, in spite of the fact that they were delivered after school hours.

For several years these lectures were held only at the Museum. Later, because of the difficulties of transporting large numbers of children through the city streets, and because the Museum authorities realized that many parents could not afford the necessary carfare, courses of the lectures were given in some of the schools. At the present time the system has been so developed and extended that our lecture service includes annually two long series of lectures at the Museum; two series in three local lecture centers; special lectures on request at the Museum and in certain schools; lectures for student teachers in the New York Training School for Teachers; the lending of lantern slides for lecture purposes to teachers of New York City, and special instruction for the blind.

As in the case of the circulating nature study collections, the underlying purpose of all these lectures is to *supplement* the classroom work of the teacher, not to *replace* it. The individual lecture, therefore, is usually general rather than specific in its scope and is to be regarded as a series of picture stories around a common theme, and not as a well-balanced presentation of one subject. Our aim is to treat each lecture so that it may be used either as an introductory lesson to a general topic to which the teacher may refer again and again in the classroom, or as a general review after the class has finished its study. From the lecturer's standpoint these lectures are often unsatisfactory because of their diffuse character, but we must always keep before us their primary purpose, namely, supplementing the teacher's work.

The subjects are chosen with special reference to the prescribed courses of study, and deal particularly with topics in geography, history, and natural science. All are illustrated with colored lantern slides and for some years past also with motion pictures. The lecturers are members of the staff of the department of public education, all of whom have had practical pedagogical training, or members of the Museum's general scientific staff who have an especial aptitude for talking to children.

Whenever practicable the subject matter of the lectures is correlated with the exhibits in the Museum. For instance, if the lecture is on the early history of New York City, reference is made to the eastern woodlands hall, where the life of the Indians of Manhattan is depicted; if the subject is physical geography of the United States, reference is made to the halls of geology and to the halls of the great vertebrate fossils, where early earth history can be read and visualized.

In addition to the regular courses of lectures for school children, members of the Museum staff lecture at the New York Training School for Teachers, with the purpose of presenting to the student teachers certain background topics on which the lecturers are especially well qualified to speak. The result of this relation to the Training School is far-reaching.

Many special lectures are given to visiting classes, particularly those from high schools. Twice a year during Regents' Week, the examination period, the biology classes from several of the high schools are brought to the Museum, are given a lecture in the auditorium on some biological topic, and are then sent into the exhibition halls with a questionnaire for further study. Thus for these classes, as well as for groups of Boy Scouts, Girl Scouts, Woodcrafters, etc., the Museum exhibition halls serve for great indoor field trips.

A few years ago the Museum's lecture service was extended by the establishment of local lecture centers. Under this plan a centrally located school which has proper facilities is selected and the schools of the neighborhood are invited to send their classes to this school for the Museum lectures delivered there. For some time the Museum has been maintaining three such centers; namely in the Washington Irving High School; Public School 64, Manhattan; and Public School 42, The Bronx. The center at the Washington Irving High School approaches the ideal. One of the high school teachers makes all the arrangements with the local schools. On the appointed days the Museum lecturer goes to the center and then speaks to the pupils from the neighboring elementary schools. Thus these children have the benefit of the lectures without the long and hazardous journey to the Museum. There is no doubt that the local lecture center scheme should be extended.

Another important branch, recently developed, of the Museum's educational work is the lending of lantern slides to the teachers for use in the classroom. This work was undertaken in 1915 under a special grant from the Board of Education of New York and its almost phenomenal growth bids fair to make it the most extensive, if not the most important, of the visual instruction methods of the Museum. Through its expeditions and researches the Museum has accumulated many thousands of negatives and photographs. From these has been built up its lantern slide collection, now numbering 31,000 slides and covering a wide range of subjects. New material is being added continually. These slides are lent free of charge to any teacher in the New York public schools. Museum messengers deliver the slides to the schools and call for them at the end of the loan period, one week. Printed catalogues of the slides and order forms are sent out to teachers or are available on request.

Realizing the many demands on the time of teachers the Museum has further anticipated their needs by preparing a series of lectures illustrated with from sixty to eighty slides and accompanied by a suitable manuscript, which enables the teacher to give a lecture with a minimum of effort. Nearly 43 per cent. of the slides lent are in these prepared lecture sets, although they comprise only about one tenth of the number in the general file. In all there are thirty-seven of these sets, twenty of which have been duplicated. The subjects of the lecture sets are as varied as those in the regular lecture courses, including geography, history, industries, literature, art, and natural science.

The principal limitation on the use of this material at present is the lack of facilities and projection apparatus in the schools. The school authorities are slowly remedying the situation and the demands of the future will be greatly increased. As it is, 182 public schools of

Through the Jonathan Thorne Memorial Fund, the American Museum has been able to develop its work among the blind. The sightless child is permitted to handle specimens and thus secure an impression of the size and the form of an animal and "see" whether its covering is of fur, or scales, or feathers. The little girl in the picture is learning the configuration of the world by running her finger over the raised areas representing the continents

the city are being served regularly and the number of loans, the best index of growth, have increased from 1470 in 1919 to 3963 in 1921, or about 190 per cent.

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 and are taught by trained teachers under the guidance of a special supervisor. In the Museum's program of education special provision is made for these children. In consultation with the supervisor for the blind, informal talks, which can be illustrated with actual specimens or with apparatus, are prepared by the Museum staff under such titles as "Birds of Our Parks," "Indians of the Plains," "Animals That Give Us Clothing," "Sea People and Their Castles," "The Change of Seasons," and are given at the Museum.

The small number of pupils—from nine to twelve in a group—makes it possible for each child to "see" carefully every article under discussion. These talks are planned both to supplement the prescribed school work and to add interest and general knowledge to the life of the blind child. The results from this work are gratifying. Oftentimes it is read in the happy faces of the children. Again it is seen in the essays based on

The life of the Antarctic has its fascinations for the children that visit the American Museum. The feeding of a young king penguin suggests an act of cannibalism on the part of the parent, but the label accompanying the exhibit explains that the young bird is securing food instead of serving as such

the lesson that are prepared by the children. One teacher writes: "General class instruction is easier because of their visits to the Museum. Children of little experience in life and meagre opportunity for general information speak with some ease and familiarity of animals, birds, people, and customs about which they have been informed under your guidance. I thank you heartily in behalf of these children, who scarcely realize to what extent you are broadening their horizon."

In the foregoing article we have presented the principal features of the methods of visual education employed by the American Museum of Natural History. We make no claim that they are new to education. They have been modified to meet the conditions in New York City. The wealth of material in the exhibition and study collections of the Museum, which its men of science have brought together from all parts of the world, the miniature collections, and the extensive series of negatives and slides that through the school service of the Museum are made freely available, give the New York child a rare opportunity to visualize his geography and history lessons, and offer compensation in a measure for his lack of contact with the outdoor world.

THE SCHOOL SERVICE BUILDING

AN ADDITION TO THE AMERICAN MUSEUM THAT WILL MAKE POSSIBLE FULLER COÖPERATION WITH THE PUBLIC SCHOOLS

ON APRIL 21, 1922, the Board of Estimate and Apportionment of the City of New York unanimously appropriated $570,000 for the construction and equipment of the SCHOOL SERVICE BUILDING of the American Museum of Natural History. This action of the city authorities opens a new period in the history of the Museum's relation to the schools and is significant appreciation of what the Museum is doing in bringing nature to the boys and girls of the city.

The work of the Museum with the schools during the last eighteen years, which is described in the preceding article of this number, has been carried on with inadequate facilities. The department of public education, which has immediate charge of these activities, has been housed, for the most part, in corridors, basements, and anterooms in various parts of the present edifice. In fact, under the circumstances, it is surprising that the Museum has attained the position of usefulness it now holds in the educational system of the city.

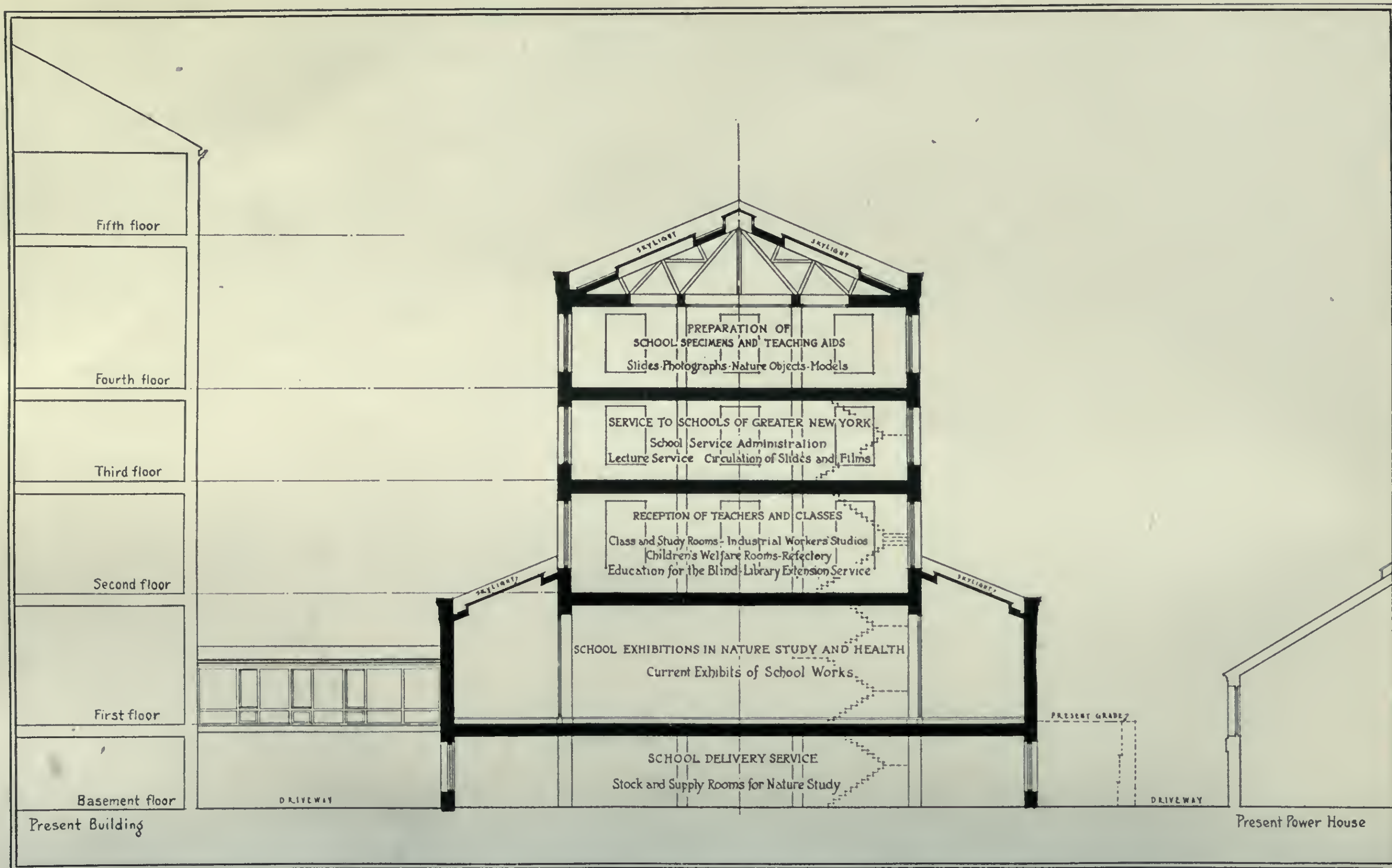
The SCHOOL SERVICE BUILDING is to be located in the southwest court of the Museum. It will be a four story and basement structure, connected by covered bridges on the first and second floors with the north wing on the east and the southwest wing on the west. The basement and first floor will be 160 x 88 feet, and the second, third, and fourth floors will be 160 x 53 feet. The height from the basement to the peak will be 91 feet and the cubical space approximately 1,000,000 feet.

In the basement will be housed the school delivery service and here will be the stock and supply rooms for the nature collections which are loaned to the schools. Coat rooms to meet the needs of 500 pupils will also be located in the basement. This will still leave considerable space for the storage of cast molds and study material used in making the exhibits in the Museum.

The first floor will comprise a large, open central hall 160 x 52 feet with a series of alcoves 18 feet deep along the sides. In the alcoves are to be displayed the food and public health exhibits, which have been so well prepared under the direction of Honorary Curator C.-E. A. Winslow. These exhibits are especially valuable for instruction in civic biology and applied science. The central hall is planned primarily for temporary exhibitions of special interest to schools or to the general public,—such an exhibition, for example, as the flower show, prepared in 1921 under the auspices of the New York Biological Teachers Association, exhibits of posters and other school work, or exhibits of current interest, such as the annual flower show of the New York Horticultural Society or the radium exhibit held at the time Madame Curie visited this country.

The second floor will be given over to the reception of teachers and classes visiting the Museum. Its use for such purposes will fill a long-felt need in the Museum. At the present time it often becomes necessary to close off an exhibition hall in order to provide accommodation for visiting classes. On the second floor as planned will be found class and study rooms, a refectory where light school lunches may be served, and several lecture rooms. A special feature will be rooms equipped for industrial workers in art and design. In this way the Museum's rare material will become the inspiration of practical craftsmen. The education for the blind and the Museum extension service to the libraries will be provided for on this floor.

The third floor will be devoted to the activities connected with the Museum service in the schools. The offices for school service administration will be on



TRANSVERSE SECTION OF THE SCHOOL SERVICE BUILDING, AMERICAN MUSEUM this floor. Here, too, will be the Museum's library of lantern slides, now numbering more than 35,000, which are loaned to the public schools of the city. At one end of the library will be the slide librarian's office and the shipping and receiving room for the distribution of slides. An important feature will be the teachers' consultation room with sample projection room adjoining. This consultation room will be equipped with tables, each having a ground glass top illuminated underneath with electric light for the use of teachers in selecting and assembling slides for lectures. A practise lecture may then be given in the projection room adjoining. This will be especially valuable to the student teachers from the training schools. On this floor there will be also a school library and teachers' reading room, connecting with a room in which will be displayed typical exhibits that will show at a glance the facilities of this character that the Museum offers.

The fourth floor is to be practically the school laboratory and will provide for the preparation of specimens for schools and other teaching aids. There will be a large photographic studio for the production of slides and pictures, a motion picture laboratory for studying and editing films, a room for coloring slides, and a study projection room with motion picture projector and stereopticon. This floor will also contain the library of negatives and photographs, numbering about 60,000, which is the principal source of the slides for lectures. The library of electros and blocks used in the Museum publications will be stored here.

It is estimated that from 3000 to 5000 children daily may be properly taken care of in the School Service Building, or from ten to twenty times the number that the present facilities of the Museum will permit.

How highly the educational service of the Museum is estimated may be inferred from a reading of the following Resolution adopted by the Board of Superintendents of the Board of Education of New York City on March 27 by way of endorsement of the application of the American Museum for funds for the School Service Building:

Whereas, The American Museum of Natural History since 1881 has been conducting educational work with teachers, and since 1904 has been supplying the public schools of The City of New York with lectures and with nature-study material of all kinds, with lantern slides and other visual education aids in teaching geography, history and natural science; and

Whereas, The American Museum, entirely at the expense of the Trustees, through its explorations in all parts of the world, is bringing to New York rare and valuable educational specimens which are made freely available for the use of the teachers of the City; and

Whereas, The Museum is lacking in adequate facilities for receiving the school children who visit the Museum and for housing the administrative work connected with its coöperation with the public school system of the City, and has therefore made application to the Board of Estimate and Apportionment for the appropriation of $570,000 for the erection of a four-story School Service Building in the southwest court of the American Museum of Natural History;

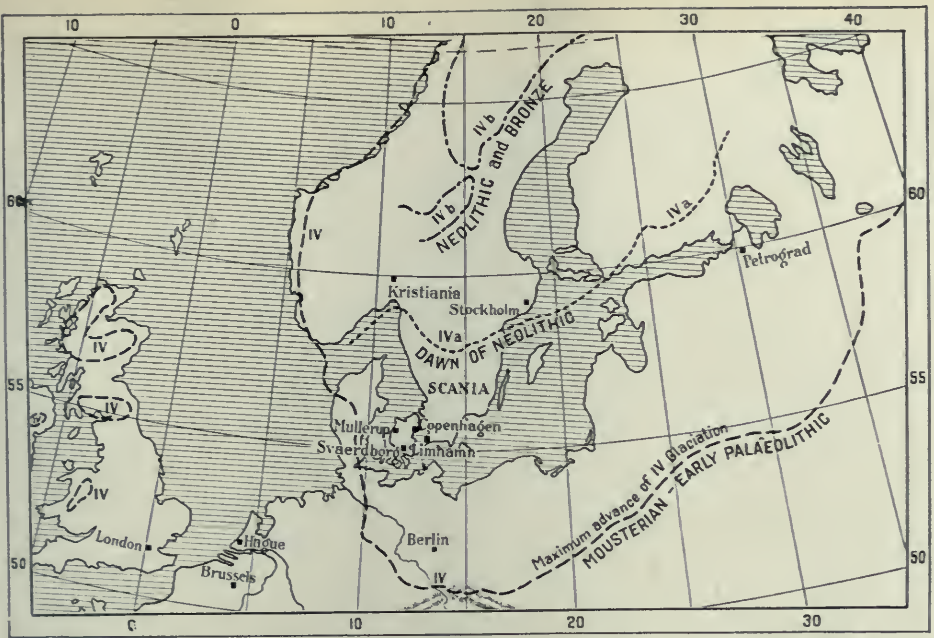
Resolved, That the Board of Superintendents of the Board of Education of The City of New York desires to record its unreserved approval of the valuable service which the American Museum is rendering to the schools of The City of New York, and heartily indorses the plans of the Trustees for making it more thorough and effective, and hereby recommends to the Board of Education that it request favorable consideration from the Board of Estimate and Apportionment of the Museum's application for funds to erect and equip the School Service Building.

As President Henry Fairfield Osborn has well said, "Education is a great deal more than the three R's: it is inspiration as well as information; it is instruction in local history, in geography and geology, in travel, in climatic laws, in the simple economics of food, in all that concerns personal health of mind and body, in the natural history of flowers, forests, streams, of insects, fishes, birds, and mammals, in all that living nature has to tell our youth." It is this real education that will be advanced by the School Service Building.

George H. Sherwood,
Curator of Education,
American Museum.

Gerard De Geer, the leading geologist of Sweden, who has established (1910-1921) the glacial chronology of Scandinavia through the discovery of the clay laminæ

Oscar Montelius, the leading archæologist of Sweden, recently deceased, who established the entire succession of the Neolithic, Bronze, and Iron Age cultures in Sweden, and—shortly before his death—connected the archæology with the glacial chronology of De Geer



Lines of retreat of the final Scandinavian glacial cap which exposed the southern extremity of Scania about 12,000 years ago, contemporaneous with the succession of human industries, namely, early Palæolithic-Mousterian, Neolithic, and Bronze. Lines of glacial retreat after De Geer, drawn by C. A. Reeds

OUR ANCESTORS ARRIVE IN SCANDINAVIA*

BY

HENRY FAIRFIELD OSBORN

THIS article, the fourth in the series on early man in Europe, covers the eight milleniums of time from the close of the Reindeer Period of the Old Stone Age in Scandinavia to the Age of Bronze, including the dawn of the Neolithic or New Stone Age, now dated at 3500 B. C., when the art of polishing flint and other stone implements reached Scania. It deals with a region which during the early part of the Reindeer Period in France was wholly uninhabitable because it was buried under the ice sheet of the great Scandinavian Glacier.

We shall describe the evolution of the great flint industry known as the Campignian, named after its type station of Campigny, France, an industry especially adapted to the needs of a hardy northern race living in a forested country along river banks or seashores where there could be no recourse to limestone caverns or grottos for shelter. These people built their *cabanes* (huts) partly below the surface of the ground and probably stretched the hides of animals over arched poles in building them. Such a style of building—not unlike that still in vogue among the nomadic peoples of Mongolia and northern Siberia, in which the fire is placed in the center of the dwelling and the smoke emerges through an opening in the roof—called for a constant supply of seasoned firewood, while the streams and the inlets

*"Our Ancestors"—Perhaps few people realize how many of the surnames of native-born Americans are, either directly or ultimately, of Scandinavian origin. An instance of this is afforded by both family names of the writer of this article. Osborn is a variant of the Old Norse name 'Asbiorn' = divine bear (O.N. as, divine + biorn, a bear), Anglicized into Osbeorn, Osbern, Osborn = a godlike warrior (O.E. os, a god + be (o)rn, a warrior). Two Osberns are recorded as killed in battle in 1054 A.D. and the name is of common occurrence in the Domesday Book. Sturges (=Sturge's son), the surname on the distaff side, is somewhat obscure in derivation but seems to be related to the O. E. 'sterced' = stern, stout, strong, and perhaps to O. E. 'stearc' = rigid, stern, strong.—EDITOR.

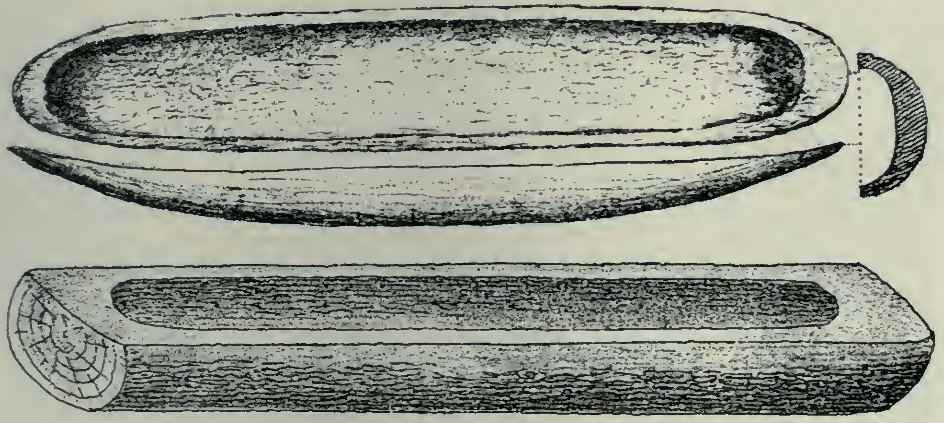
Upper—Tent of a Reindeer Koryak of northern Siberia, supported by poles from within, and covered with reindeer hide.

Lower—Drawings believed to represent huts and shelters built of poles and covered with hides, of Magdalenian (Late Palæolithic) age, found on the walls of the cavern of Font-de-Gaume, France. After Breuil

of the adjacent seashores rendered urgent the need of canoes. Whether the log canoe was a western invention, or whether the idea of canoe building came from the east, we cannot be sure; but it may safely be asserted that the flint *tranchet* (prototype of the ax), the flint *pic* (prototype of the pick), possibly the skin-covered *cabane*, and quite probably the log canoe, were brought in as new and striking features of this culture period, and that as early as 7000 B. C. the inhabitants of Denmark possessed implements capable of felling a tree and fashioning a log canoe.

For three reasons this period of eight thousand years is of special interest. First, it witnessed the arrival of our northern ancestors in northwestern Europe. Second, as the Mesolithic or transition stage, it fills in the interval of prehistory, until recently unknown and mysterious, that lies between the Magdalenian industry of the Crô-Magnon race of artists—that is, the close of the Old Stone Age in Europe—and the dawn of the New Stone Age, characterized by the practice of polishing stone implements, the pursuit of agriculture, and the domestication of animals. Third, it has recently (1910) become possible to assign dates to these industries with greater precision than to the dawn of civilization in central Asia, Mesopotamia, and Egypt. Geology furnishes the chronometer in the seasonal melting of the Scandinavian Glacier with its annual deposits of the fine ice-borne clay by which the years are recorded as distinctly as in the annual ring growths of trees. The discovery that thick clay layers near Stockholm correspond with warm seasons of rapid melting, and thin clay layers with cool seasons of slow melting, suggested to the ingenious mind of Baron Gerard De Geer that here was the long-sought time clock of glacial recession. By the year 1910 he confidently announced a *Geochronology of the Last 12,000 Years* and began a decade of persistent research along the ancient ice-borders of Scandinavia and, more recently, of northeastern America, which has not only confirmed his original theory, but of late[1] apparently promises a means of fixing precisely the date of postglacial time in the northern hemisphere.

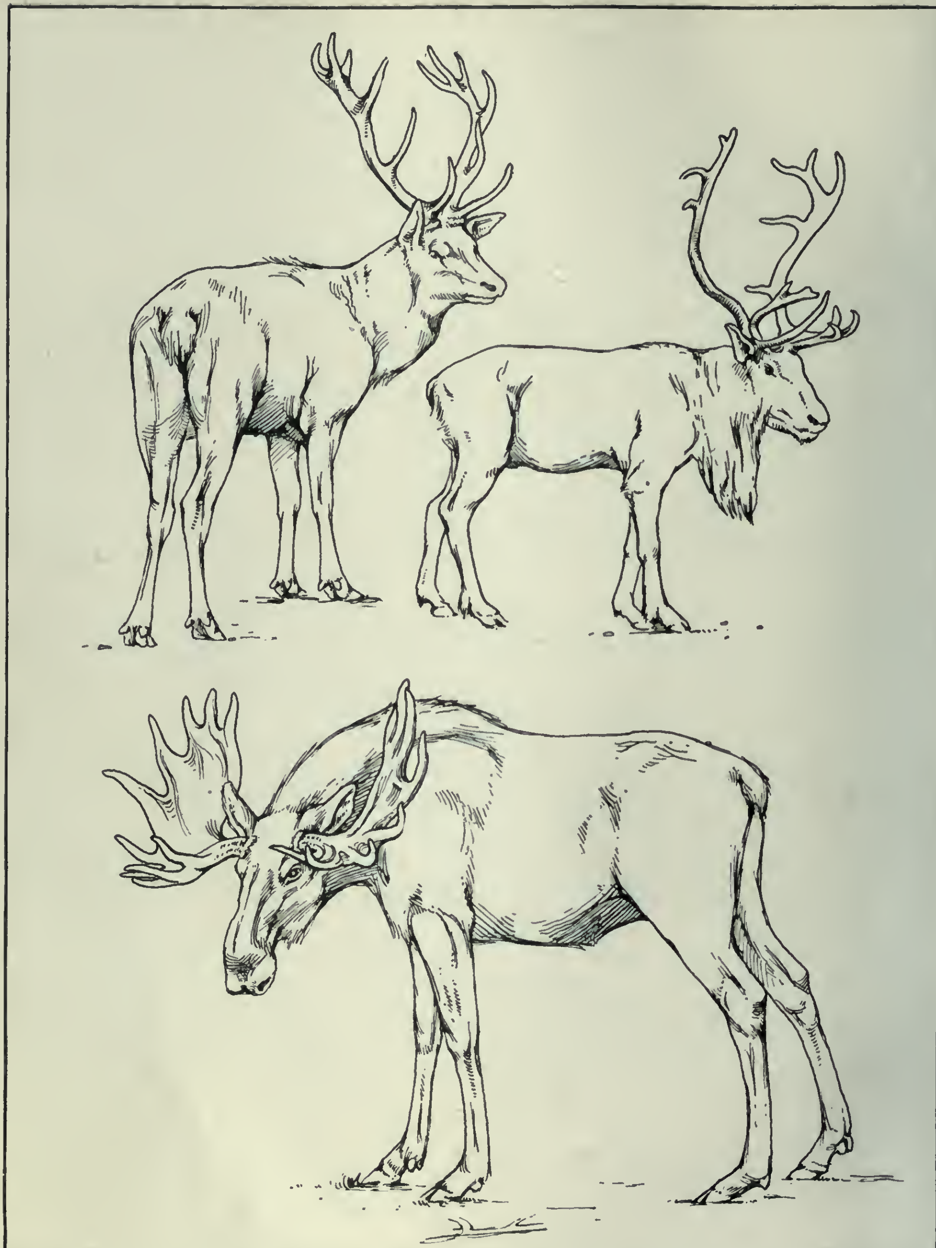
The date when our ancestors arrived in Scandinavia is thereby set by Baron De Geer and by Oscar Montelius,[2] the distinguished archæologist of Scandinavia, as 10,000 B.C. for a conservative minimum and 11,000 B.C. for a maximum. Montelius has also been quick to affix the milleniums of De Geer to his previous subdivisions of the early cultures of Sweden and Denmark and



The prototype of the Viking ship. A number of log canoes are preserved in the museums of Christiania and Stockholm. In the absence of a suitable design from Scandinavia we have selected for illustration two canoes from the Lake Dwellings of Switzerland. After Keller.
Upper—A log canoe from the station of Robenhausen—top view, side view, and cross section
Lower—A primitive log canoe or 'dugout' from Möringen

[1]De Geer, Baron Gerard, "Correlation of Late Glacial Annual Clay Varves in North America with the Swedish Time Scale." *Geologiska Föreningens i Stockholm Förhandlingar*, Bd. 43, H. 1-2. January-February, 1921.

[2]Since the inception of this article the writer has learned with deep regret of the death of Dr. Oscar Montelius on November 4, 1921, through which the study of the prehistory of Europe has suffered an irreparable loss. Widely known as the leading archæologist of Scandinavia, he was for more than fifty years a constant contributor to the scientific journals of his own and other European countries—being an accomplished linguist—as well as the author of numerous books. In addition he was for many years director of the National Museum of Sweden, an office which he recently resigned in order to complete a series of monographs on the unique collections assembled there. The present article owes much to his help and warm personal interest.



The three great game animals of western Europe, which migrated southward before the advancing cold, and returned northward following the retreating ice. All of the same relative size.

The REINDEER migrated southward to the Pyrenees in time of maximum cold, and then slowly retreated northward to southern Scandinavia about 11,000 B. C.

The MOOSE (Scandinavian Elk) wandered southward into northern Spain during the period of maximum cold and retreated northward to Denmark where its bones and horns were used to make weapons and tools in the Maglemose industry of about 7000 B. C.

The STAG, which was depicted by the Magdalenian artists of northern Spain, moved northward, appearing in the early Campignian and Shell Mound deposits of Denmark and Sweden about 5000 B. C.

to propose a series of dates far more precise than those given for any other prehistoric region of the world.

This definite and reliable chronology afforded by the glaciers is doubly welcome because the old divisions of the prehistory of Europe into the Old Stone Age, New Stone Age, Age of Copper, Age of Bronze, and Age of Iron, no longer suffice. They are not only too broad, they are too indefinite, since it is now well known that these cultures overlapped, so that the Old Stone Age of one region corresponds with the New Stone Age of another, and even with the Bronze Age of a third. Not only this overlapping of cultures and industries, but the gradual transitions between these periods—the intermediate stages recently discovered—render a new chronology necessary. This is especially true of the time when our Nordic ancestors arrived in Europe, when the stag had replaced the reindeer all over France and Belgium, and even the moose, or Scandinavian elk, had retreated northward into Denmark, while the reindeer was following the snow fields and retreating ice northward from Denmark into southern Scandinavia.

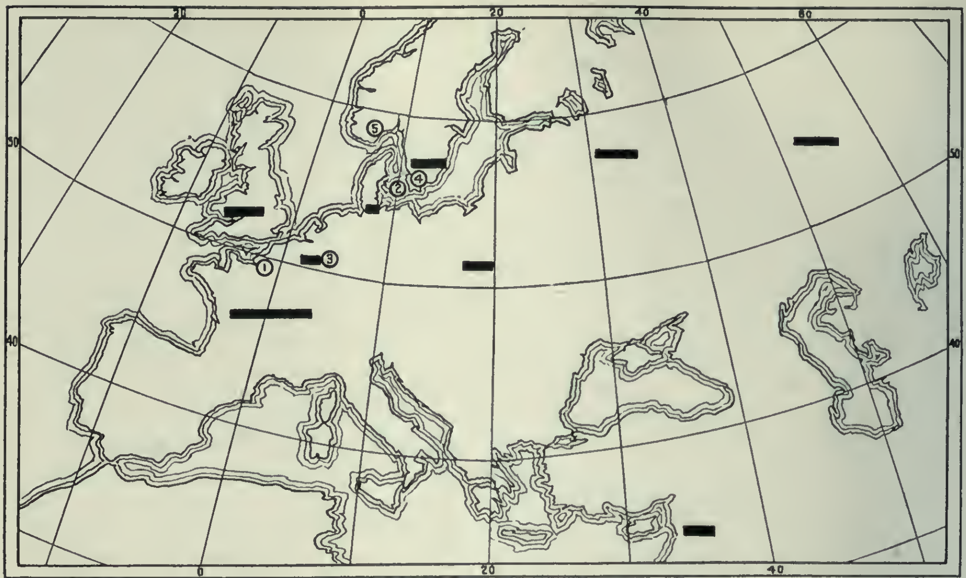
NORTHWARD MIGRATION OF INDUSTRIES

When we realize that the reindeer during the period of high Magdalenian art of the Crô-Magnon race had penetrated Spain south of the Pyrenees and was abundant in the cave region immediately north of the Pyrenees—its hide furnishing clothing; its flesh and marrow bones, food; its horns and leg-bones, weapons and tools—we secure the key to the origin of a variety of human habits and inventions which moved northward twelve hundred miles from Spain to southern Scandinavia. This northward retreat of the reindeer began after the time of the maximum cold of the Fourth Glaciation, and continued for from 8,000 to 10,000 years during the period of the development of the Upper Palæolithic cultures, namely, the Aurignacian, Solutrean, and Magdalenian, and into the minute flint industry of the Tardenoisian.

All the inventions, everything which tended to make life more comfortable, to facilitate the capture of fish or game, moved northward with the hunting tribes. Some of these inventions, like the flint hide-dressers and scrapers, date away back to the time when the Piltdown man and the Foxhall man inhabited western Europe. Others, like the bone sharpeners and shapers, finely retouched flint tools, also flint borers used in perforating bone, date back to Aurignacian times when the manufacture of bone implements began to flourish. Still others, like the minute geometric flints known as Tardenoisian, which may have been introduced from Africa, date only from the Stag Period, which was post-Magdalenian. It is wonderful to find these tiny flints—as pointed out to the writer by Dr. Hamal-Nandrin of Liége—in fishing stations of the very late Reindeer Period of the north, and again at a time when the moose and reindeer had deserted the station of the Grotte de Martin-Rive, and the stag had replaced the reindeer.

The one industry which did not follow the reindeer north was that of the Aurignacian and Magdalenian artists and sculptors of the Crô-Magnon race, and this was left behind because it was not useful or essential to the daily life or food supply of people who were too much occupied with the struggle for existence to develop the æsthetic, or spiritual, side of their nature. Like the American pioneers these Scandinavian people had no leisure for art: they were too busy with fishing, hunting, tent making, and boat building. Nevertheless the art spirit was in them, although latent, and we find it asserting itself about 2000 B.C., as evidenced by most beautiful designs in bronze implements and ornaments made about that time.

It is in the extreme north, close to the retreating ice sheet, that, through the genius of Baron De Geer, we are enabled



Geographic distribution of Campignian industry as given by Salmon, d'Ault du Mesnil, and Capitan in 1898, to which the following sites (indicated by numbers in circles) have been added.

1—Campigny, France, type station of the Campignian culture.
2—Mullerup (Maglemose), type station of the Maglemose culture, and Sværdborg, where extensive industrial remains of Maglemose type have been discovered.
3—Region of extensive Campignian quarries in Belgium, explored by M. Hamal-Nandrin and others
4—General region on the southeastern coast of Scania, Sweden, where Campignian implements are found.
5—Campignian outposts of Norway.

to assign exact dates, not only to the successive northward migrations of reindeer, moose, and stag, but to the corresponding waves of human invention and human migration; and to the interchange of weapons of the chase and tools of successive industries. Oscar Montelius—leader of Swedish archæology and close friend of the leader of Swedish geology, Baron De Geer—has himself given us for NATURAL HISTORY the prehistoric milleniums of Scandinavia.

REINDEER PERIOD OF SWEDEN AND DENMARK
(12,000?) 10,000–8000 B.C.

The Reindeer Period of Sweden and Denmark was, as shown in the above table, subsequent to the Reindeer Period of southern France. The southern border of the great Scandinavian Glacier had retreated northward, so that the ice front was not far from the present site of Stockholm, which at that time was depressed more than six hundred feet below the present sea level. A small mollusk, *Yoldia arctica*—partial to icy currents—was flourishing along the eastern shores of Scania, and ice-loving seabirds were migrating eastward and westward over Scania and Finland. Following their favorite game the hardy hunters of the reindeer invaded this country with giant flint implements of archaic type, which remind us of the great stone hand axes of the Old Stone Age although they are retouched about the borders with the deftness of Solutrean workmanship. Such implements are very rare and are chiefly of amygdaloid (almond-like) form—a form which harks back to Chellean times. According to Montelius these implements are of the same age as, or perhaps a little

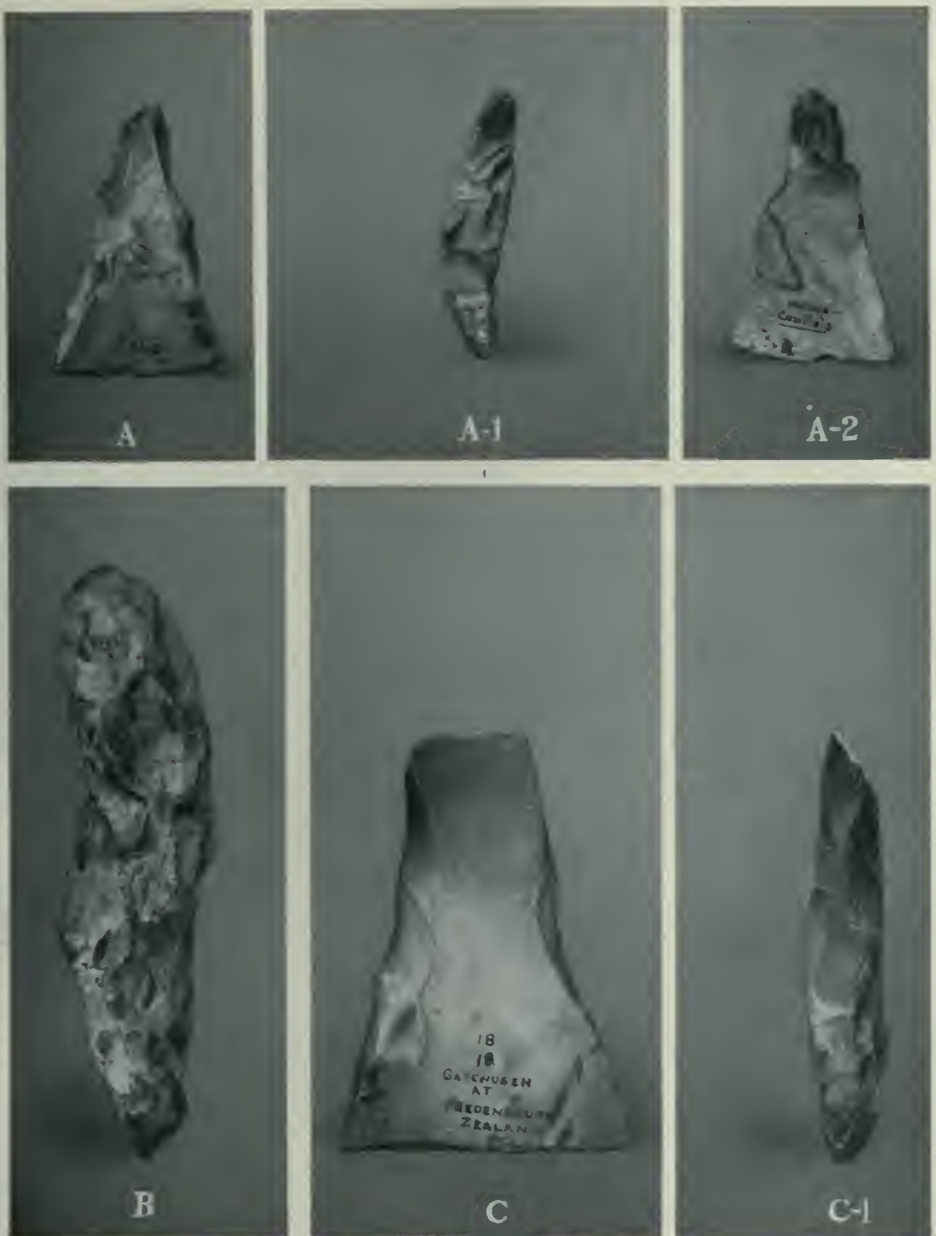
CHRONOLOGY OF SCANDINAVIAN CULTURES

Approximate chronology of the Palæolithic, Neolithic, Copper, and Bronze cultures of western Asia and Europe. These dates are largely conjectural and may be greatly modified by future discoveries.	B. C.	Archæologic chronology of southern Scandinavia as given to the author by Oscar Montelius in the summer of 1921, slightly modified by the more recent determinations of De Geer and Antevs that the ice retreated from central Scania not earlier than 11,500 B. C.
AGE OF BRONZE in central Europe, France, Spain . . . . HORSE domesticated in the Orient	2000	AGE OF BRONZE
	2200–1700	STONE CISTS. Inferior pottery. First appearance of BRONZE in Sweden
COPPER used in central Europe and France . . . . AGE OF BRONZE in Troy, Greece, and Sicily.	2500	PASSAGE GRAVES. Painted pottery. First appearance of COPPER
AGE OF BRONZE in Egypt and Chaldea . . . . COPPER used in Troy, Greece, Sicily, Hungary, and Spain.	3000	Earliest Scandinavian SKULL of NORDIC type DOLMENS—round or rectangular
COPPER used at Anau, Turkestan	4000	Dawn of the NEOLITHIC. No Megalithic tombs. Stone axes developed from *pic.*
COPPER used in Egypt and Chaldea	5000	SHELL MOUND and CAMPIGNIAN cultures. STAG PERIOD
	6000	
	7000	MAGLEMOSE (Mullerup) culture of Denmark—DOMESTIC DOG
CAMPIGNIAN culture in France . NEOLITHIC culture at Anau, Turkestan	8000	MOOSE (ELK) PERIOD in Scania
	9000	
	10,000	OUR ANCESTORS ARRIVE IN SCANDINAVIA with large flint implements and axes of reindeer horn
Close of REINDEER PERIOD in southern France.	11,000	REINDEER PERIOD in Scania
	11,500	Final retreat of the Scandinavian Glacier from southern Scania
Crete settled	12,000	
	13,000	
	14,000	
	15,000	
MAGDALENIAN (Palæolithic) culture in France . . . . NEOLITHIC culture at Susa, Persia	16,000	
	17,000	
Beginning of NEOLITHIC in southwestern Asia	18,000	

Survival of the laurel-leaf point (*feuille de laurier*) type derived from the Solutrean (Late Palæolithic) culture of western Europe, copied and imitated—doubtless for purposes of the chase—and included in Swedish Neolithic burials. One third actual size. After Montelius

more recent than the clubs of reindeer horn from Denmark, which are among the most precious exhibits of the Copenhagen Museum. Two of these have a hollowed groove in which a flint flake was inserted. A single arrow head of flint was also found near one of them.

The branch of the human race to which these reindeer hunters belonged has not yet been satisfactorily demonstrated, but in the opinion of Montelius it is quite probable that they were true Scandinavians of Nordic type,—a type of which Montelius himself was such a fine example. To quote Montelius freely the ice began to melt and to retire from the southern coast of Scania more than thirteen thousand years ago (11,500 B.C.), whereupon plants and animals migrated there and with them came man. Among the flint implements found in Scania are two closely resembling the double-pointed laurel-leaf type characteristic of the Solutrean of France. Such forms occur only near the southern and western coasts of Norway and Sweden, which were the first to become ice-free. In Denmark also a flint spearhead has been found which resembles the Solutrean form. Montelius holds that these flints demonstrate the presence of man in Scandinavia during Solutrean times, and concludes that the reindeer hunters of Scania belonged to the Crô-Magnon race—an opinion which the present writer is not inclined to accept, since it seems far more probable that the first reindeer hunters in Scandinavia were fair-haired ancestors of the existing Scandinavian races. It is certain that the first races migrating into Sweden were long-headed, and the earliest human skeletons and skulls well enough preserved to be studied are in the main

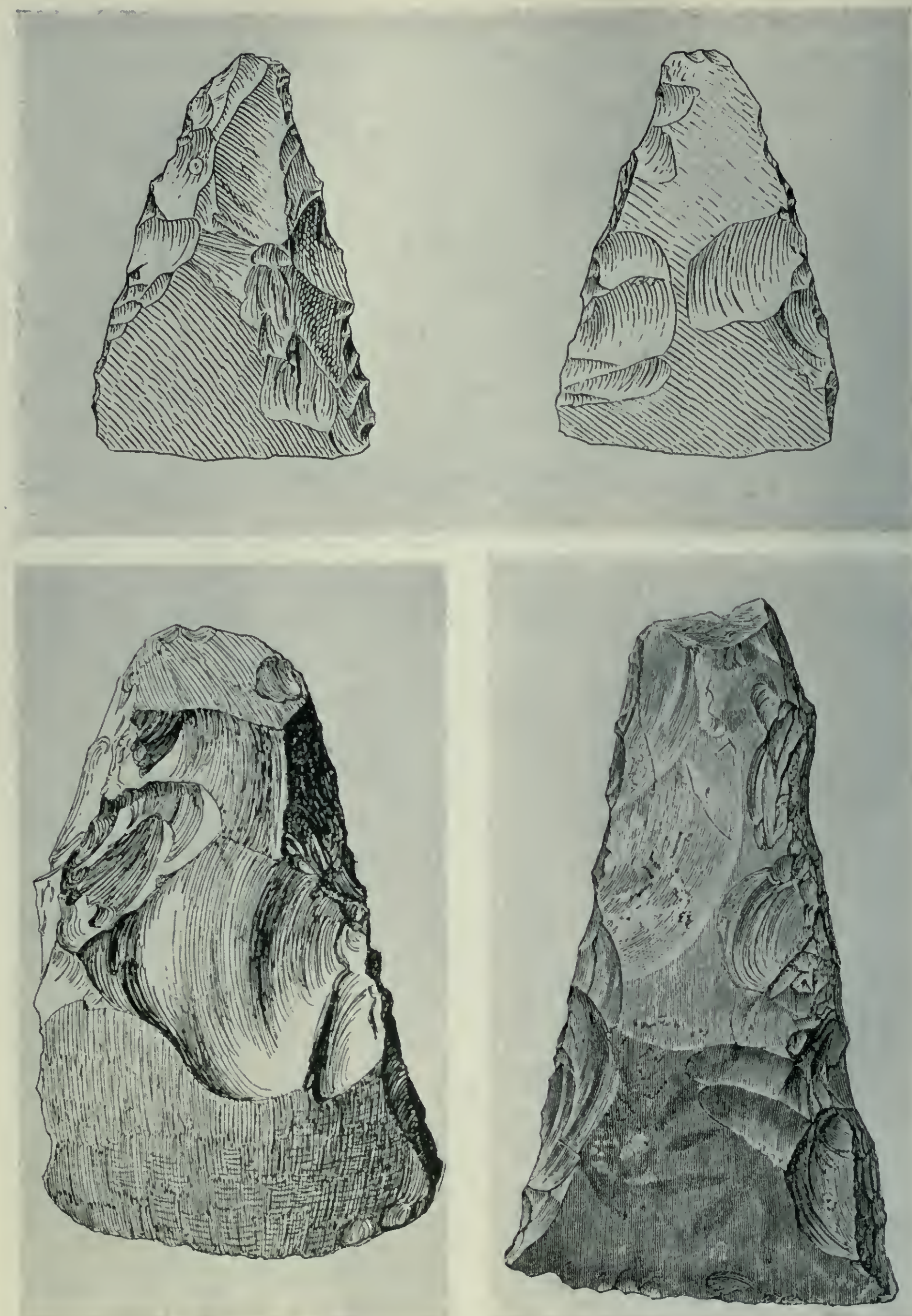


Prototypes of ax and pick, our pioneer implements. The *tranchet* and the *pic*, as they were fashioned at Campigny, France, and later in Scandinavia, from specimens in the American Museum of Natural History. All one half actual size.

A, A-1, A-2—*Tranchet* from Campigny, showing both faces and one side view

B—*Pic* from Campigny

C, C-1—*Tranchet* from Sweden, showing one face and one side view



The flint ax of the primitive Scandinavian forester and woodsman, as it evolved from the typical flint *tranchet* of Campigny, France. All actual size.

Upper two—*Tranchet* from Campigny, France. After Salmon, d'Ault du Mesnil, and Capitan

Lower left—*Tranchet* from Sværdborg, Denmark. After Friis Johansen

Lower right—*Tranchet* from Sweden. After Oscar Montelius dolichocephalic, the oldest dating back to 3000 B.C. in the chronology of Montelius. There is no evidence of the occurrence of the broad-cheeked Crô-Magnon type of late Palæolithic Age in the oldest Scandinavian graves.

THE MOOSE PERIOD IN SWEDEN AND DENMARK 8000–5000 B.C.

MAGLEMOSE (MULLERUP) CULTURE OF DENMARK

The reindeer followed the ice sheet northward and was succeeded by the moose, which was so abundant in Denmark that it dominated the industrial as well as the hunting life. This was the period known to geologists as the Ancylus Time, when Scandinavia united with Denmark and Finland, shutting out the North Sea and the Arctic Ocean and thus converting the Baltic into a great fresh-water lake. For archæologists this time is characterized by the industry of the Peat Bog (Maglemose) near Mullerup—a name derived from the peat bed in Denmark where a dwelling was discovered and excavated by Sarauw in 1903. Sarauw thought that the people lived on rafts or floats—an error, since it is now known that they dwelt on very low islands or lake borders, a fact brought out in the neighboring peat station of Sværdborg, described by Johansen in 1919.[1]

The fact that we have now left the Reindeer Period and the Old Stone Age of Europe and are witnessing the dawn of the transitional or Mesolithic, leading to the New Stone Age, is clearly established by the absence of any trace of pottery and by the first appearance of two implements which are entirely new in the industrial prehistory of Europe. These are the *tranchet* and the *pic*. Crude as they are, the *tranchet* and the *pic* represent two inventions new to this part of Europe which are destined to be of transcendent importance to the human race, and which relate Maglemose and Sværdborg to the industry of Campigny, France, about 560 miles to the southwest.

The low coasts of Denmark were ill supplied with native flint, and it is by no means impossible that the few *tranchets* and *pics* may have come by trade from some of the rich flint quarries of Belgium or France, in which the Campignian industry had formerly flourished.

The Maglemose and Sværdborg workers were favored by the abundance of moose, stag, roe, and wild cattle (*Alces machlis*, *Cervus elaphus*, *Cervus capreolus*, *Bos taurus*), which richly compensated them for the paucity of flint. They manufactured bone tools of every kind, especially for their clothing industry—hide dressers, polishers, scrapers—and for the more serious work of the chase they inserted their cutting and piercing flints in bone hafts and handles. A brief survey of the splendid collection from Sværdborg in the Copenhagen Museum reveals sixteen kinds of bone implements and flint holders, fashioned chiefly from the hard horns of the stag and of the roe, including two kinds of harpoons with a single row of barbs, two kinds of bone lances, and many kinds of hafts. To fashion these bone tools there survived from the earlier Old Stone Age thirteen varieties of flint tools—scrapers, points, borers, and hammer-stones, as well as innumerable delicately pointed and dressed flint flakes, which were doubtless set in single or double rows in bone or wooden harpoons, as shown in the illustration on p.128, reproduced from Montelius.

With these numerous survivals of flint implements of the Old Stone Age there appear a few examples of the two new forms—*tranchets* and *pics*—and these are by no means well made. We may be sure that these distinctively Campignian implements were not greatly needed by the people of the Sværdborg and Maglemose region, for they had only just begun to fell the trees, hew the logs, and dig out the log canoes after the manner of the forest-loving, boat-building people of Scania. In Sweden there are

[1]Friis Johansen, Karl. En boplads fra den aldste stenalder i Sværdborg Mose. Aarböger f. nord. Oldkyndighed, 1919.

a few peat-bog stations of a similar culture with harpoons cut out of the ribs of the moose instead of the stag, and with microlithic flints, probably from dwellings on small islands in the lakes. In Denmark the game associated with this culture included, besides the large ruminants, the wild boar, the brown bear, the beaver, and the wild cat. At all these peat stations only one domestic animal is found—the dog, *Canis familiaris*, harbinger of the art of domesticating animals.

THE SHELL MOUND PERIOD OF DENMARK

A CULTURE SIMILAR TO THE FULL CAMPIGNIAN OF BELGIUM AND FRANCE. 5000–3500 B.C.

The moose has now well nigh disappeared from Denmark and southern Sweden, and with it the pine forests, so abundant in Maglemose times, a bird associated with the pine forest, the capercaillie (*Tetrao urogallus*) is no longer included in the fauna. This is the Age of the Stag (*Cervus elaphus*) and the moose is very rare except possibly in the winter season. Climatic conditions are much changed because we are now in what geologists call the Littorina Period of renewed continental depression. Since the periwinkle (*Littorina*), after which this period is named, is a salt-water animal, it is clear that the ocean again entered freely through the straits between Denmark and Scania. The Baltic Sea is entirely cleared of ice for the great Scandinavian Glacier has retreated within the shore line and is now in the postglacial stage. From the abundant shell mounds of Denmark—placed near the shores of the Littorina Sea—come four species of shells, namely: the oyster (*Ostrea edulis*), cockle (*Cardium edule*), mussel (*Mytilis edulis*), and dog-whelk (*Nassa reticulata*), besides the edible periwinkle (*Littorina littorea*). No contemporary Shell Mound dwellings have been discovered in Sweden, obviously because the inhabitants preferred the game in which the country abounded to the shellfish diet of the Danish tribes to the south, the only shell mound discovered in Sweden being of Neolithic age.

A typical seaside dwelling of Campignian times in Sweden was that of Limhamn, not far from Malmö and opposite Copenhagen, where we find ourselves in the presence of a fully developed flint industry of the perfected Campignian. Very abundant are the *tranchets* and *pics*, fashioned closely after those found in the typical Campignian station of Campigny, France, about 630 miles to the southwest. Among these flint workers many of the older implements are still in use, as, for instance, knives for cutting flesh, arrow points for the chase, scrapers for hide-dressing, borers for the perforation of eyelet holes and the piercing of skin and bone. The arrows and harpoons of bone—so abundant in the industry of the Maglemose and Særdborg camps in Denmark—are exceedingly rare or have completely disappeared. It is in-

A harpoon made of bone with a double row of barbs, in the Museum of Stockholm, to be compared with the harpoons made of reindeer horn of Magdalenian Age found all over France. One half actual size

A polished Neolithic ax, successor of the Mesolithic *tranchet*, inserted in the leg bone (tibia) of a stag—one of the chief treasures of the Stockholm Museum. Three tenths actual size

teresting to note that these men still barbed their harpoons with Tardenoisian microliths. Beside their fireplaces abundant shards of undecorated pottery are found.

The *tranchet* and the *pic* of this time may be compared with the very primitive forms found at Maglemose and Sværdborg, which in Montelius' chronology are considered from one thousand to two thousand years more ancient. As regards the effectiveness of stone implements, the Danish archæologist, Friis Johansen, made a convincing test by inserting a flint ax-head in a haft and cutting down a tree with it. It is most probable that the *tranchet* was the prototype of the Scandinavian ax or *hache*, the implement of the wood chopper and boat builder; while the *pic* also, inserted in a haft, was useful in shaping the outside and the inside of the primitive log canoe or dugout, and may have developed into the adze of the more modern boat builder. Like the ax, the *tranchet* has a square head, and its successor, the square-headed *hache*—found only in the forested regions of Scandinavia and northern Germany—is the crude *hache* of the Neolithic Dolmen Period.

Each successive industrial period is now marked by the increasing perfection of two dominant implements, the *tranchet* and the *pic*, which first appeared in western Europe in pre-Campignian times but were probably brought from the east. If the *tranchet* was used for wood-cutting, the *pic* was used not only for wood-shaping but also for digging—a service which led to the use of the *pic* in mining, the type of tool so applied being made first of flint and later of metal. It seems reasonable to attribute the dawn of boat building and of mining to this latest stage of the great hunting age of man, when food consisted solely of the flesh of game, fish, or mollusks, and the agri-

A miner's pick from northern Egypt and its manner of attachment. After Jacques de Morgan. Reproduced from Figure 75 of his *L'Humanité préhistorique*, 1921, p. 157. "Pic de mineur de Ouadi el Cheikh (musée de Saint-Germain, récoltes de Seton Karr) et son emmanchement." About three sixteenths actual size cultural fruits of the earth were still unknown in Scania and Denmark, although several thousands of years previous they were developed in Asia. The art of cooking had been improved by the introduction of pottery from the east, and the chase and recovery of game facilitated by the domestication of the dog. Thus closes the transitional or Mesolithic Age.

DIVISIONS OF THE NEOLITHIC AGE IN DENMARK AND SCANDINAVIA

As we have already seen, the development of prehistoric civilization proceeded very gradually. When our ancestors arrived in Scandinavia, they brought with them an Old Stone Age culture. Then they adopted the *pic* and the *tranchet*—types which in an earlier age were actively manufactured in Belgium and northern France—for Scania was not far from Maglemose in Denmark, where a number of these tools were found. With the arrival of these tools in the north, came also the introduction of the domesticated dog. Similarly, the age of the Shell Mound and of the full Campignian cultures is marked by the introduction of pottery and of improved types of *tranchet* and *pic*. Finally there came the introduction of the art of sharpening the cutting edges of stone implements by rubbing them up and down on a smooth stone. Thus the dawn of Neolithic influence in Sweden is indicated by the polishing of implements which for thousands of years previous had been fashioned by flaking and chipping. By means of the contact established through trade and by word of mouth with the dark-haired, broad-headed peoples living to the south, stage by stage the Neolithic civilization — for such it was — came north. Among domesticated animals, goats, sheep, cattle, and swine appear in Sweden, and finally the horse—an animal destined to play a great part in Swedish mythology. Among grains the introduction of the hardy wheat and rye are followed by that of barley and millet. Finally, a wave of religious influence spreads to the north: sun worship, the idea of immortality, and the pompous ceremonial burials and monuments in honor of the dead.

The main divisions of the Neolithic period in Sweden, as given to the writer by Oscar Montelius,[1] are as follows:

IV. NEOLITHIC 2200–1700 B.C.

This is the acme of both the chipped and the polished flint industry. The flint workers learn to imitate both the forms and shapes obtained by the copper and bronze workers to the south and east.

Superb flint daggers are manufactured with a delicate retouch that far surpasses in beauty that obtained in any other part of Europe. The impulse of an artistic spirit is evident in a number of ceremonial weapons. Among these very finely finished designs in stone are those resembling bronze types—flint daggers in which even the stitching of the leather handles of the bronze weapons is skilfully simulated in flint. All these weapons are doubtless ceremonial.

The battle axes of the period have rather degenerated, and are developed in imitation of the copper types characteristic of Period III. The industrial flint axes retain the same shape as those of Period III—a modified *tranchet* form, thick at the top.

At the same time the elaboration of burial customs begins to be evident. Rectangular stone cists appear—sometimes with a small entrance passage at the gable end. There are also Megalithic burial chambers with an entrance passage, which is always at right angles to the long side of the chamber.

The pottery indicates a marked decadence in design and manufacture.

III. NEOLITHIC 2600–2200 (2100?) B.C.

The stone axes are now smaller in size, thick at the top and expanded at the bottom as if developed out of the *tranchet*.

Excellent pottery is found, resembling that of similar age in Germany and with similar patterns.

II. NEOLITHIC 3000–2600 B.C.

The Scandinavian flint adzes are now very large, finely polished on both sides, and rectangular in section—a type of adze found only in Scandinavia and northern Germany. To this period belongs the adze set in moose horn, one of the treasures of the Stockholm Museum.

The sun worship cult had by this time reached Scandinavia, and the characteristic burial dolmens of round or rectangular form, but without entrance passage, begin to appear.

[1]The result of an ever memorable conference held on August 5, 1921. The writer is especially indebted to Doctor Schnittger, assistant antiquarian in the National Museum of Sweden, for his amplification of the Montelius chronology.

I. NEOLITHIC (4000?) 3500–3000 B.C.

Prevalence of polished and unpolished flint adzes, directly developed from the *pic*, convex or concave in section, pointed at the tip and thus not derived from the *tranchet* type.

The new religion of sun worship had not yet reached Sweden, for there are no Megalithic graves or monuments.

DIVISIONS OF THE BRONZE AGE IN DENMARK AND SCANDINAVIA

During this time trade routes had been established from the southeast Mediterranean region to the northwest. The most coveted object in the Mediterranean islands and the Ægean Sea was amber from the Baltic; and the most coveted objects in the west and northwest were copper and, later, bronze. Many of the actual trade routes have been traced by Montelius until they have become well known to European archæologists.

To the writer, the most striking impression made by the superb collection of prehistoric bronzes in the Stockholm Museum, which he enjoyed observing under the guidance of Montelius, was the surpassing workmanship and the beauty of execution of the fundamental designs which came with the bronze from the distant craftsmen of the eastern Mediterranean to the craftsmen of Scandinavia—from a pure Mediterranean to a pure Nordic race. The most refined methods of bronze casting attained a high degree of perfection among these Nordic workers, in whom the art spirit, which had slumbered so long, was now fully awakened. For example, the method of casting known in France as *à cire perdue* was brought to Scandinavia and was highly developed in the ninth century B.C., about one hundred years before the foundation of Rome. The ornamentation was put on after the casting. The date of 900 B.C. is established by Montelius through finding these Scandinavian bronzes in dated tombs in Italy.

Flint poniard with a handle, on which has been imitated in flint the stitching of the leather cover of the handle. This poniard, of a design imitating a bronze poniard with its leather handle, executed with a superb flint retouch, is one of the masterpieces of the Stockholm Museum. After Montelius, *Meisterstücke im Museum vaterländischer Altertümer zu Stockholm*, 1913, Heft I, Plate ii. One half actual size

Another achievement of the Swedish craftsmen was the making of collarettes of bronze deeply incised in Mediterranean designs by means of bronze tools. Thus Sweden began to export her works of bronze art at an early period, and the facilities of trade advanced so rapidly that Montelius believes that a pottery design could have been carried in one year from the Mediterranean to Scandinavia, one of the favorite routes being by the Brenner Pass, the River Inn, and the valley of the Danube—a route now followed by modern railways. Probably such routes were used for the interchange of objects of industry long before they were used for the transport of objects of art. New religious ideas and ceremonials probably followed the trade routes. Thus, because of the occurrence of Scandinavian burial monuments in Britain, Montelius believed that he had also proved the existence of a route from Scandinavia across the North Sea to the mouth of the Humber, a route established during the Stone Age, perhaps about 3000 B.C.

PERIOD VI. 550–700 B.C.

Transition to the Age of Iron, which may be called either the last period of the Bronze Age or the first period of the Iron Age.

PERIOD V. 700–900 B.C.

Very thin bronze vessels cast *à cire perdue*, richly decorated, some designs showing the influence of the Mediterranean region. Reversed spirals. Burials with cremation; bones burnt.

PERIOD IV. 900–1100 B.C.

Round, hanging, bronze vessels. Graves, all with incineration.

PERIOD III. 1100–1300 B.C.

Small, round boxes of bronze with star-shaped design. Gold spirals. Necklaces and shawl pins. Graves mostly with incinerated remains.

PERIOD II. 1300–1500 B.C.

High art period of the Scandinavian bronze culture, elegant spiral designs, the workmanship superior to Italian workmanship contemporary with it. Beautiful bronze swords and axes, imitations of bronze axes in stone. The incineration or cremation of bodies in Sweden commenced during this period.

PERIOD I. 1500–1800 B.C.

Mostly simple types, but already displaying remarkable skill in casting, many of them imitating the Stone Age weapons. Evolution of the copper into the bronze ax with increasing economy in the use of this precious alloy of copper and tin. Active trade with England and exchange of axes. Ornamental bronze and gold objects, which are relatively small and rare. Graves with unburnt bodies.

During these six periods bronze was used most sparingly because it had to be imported from other regions, some from the British Isles but the greater part from central Europe. Copper mines were not opened in Sweden until some thousands of years after the end of the Bronze Age, and no tin has been found in Sweden. Perhaps the very rarity of the alloy led to the reverence with which it was regarded and the beauty of design which was developed. Scandinavians were acquainted with only one other imported metal, namely, gold. Montelius informs us that during the first part of the Bronze Age bodies were buried unburnt in stone cists or in coffins of hollowed-out oak. From the second to the sixth period the bodies were burnt and the incinerated bones were preserved in small cists of stone or wood, or in simple urns of burnt clay. The rock carvings of Sweden tell us much about the life of men in the Bronze Age—of their agriculture, for we see men plowing with oxen; of the chase or war, for we see men on horseback or driving; of navigation, for we see ships without masts or sails but manned with large crews; of religion, for we see the sacred wheel, the symbol of the sun god.

In closing, let us glance once more at the table (p. 123) in which we have summarized the conclusions of Montelius in regard to the archæology of Scandinavia—from the time when our ancestors arrived in that region to the Age of Bronze—set side by side with the geologic chronology of his friend and colleague, De Geer. In this table it becomes apparent that what the far-distant northwest was to our American pioneers, what *ultima Thule* was to ancient historic times, such was Scandinavia to the peoples of the Mediterranean borders. In the course of thousands of

Bronze bowl and bronze collarette—two of the most beautiful objects in the Stockholm Museum—decorated with the incised spiral designs which Montelius believed to be derived from Mycenæan motifs. Reproduced from Montelius' *Meisterstücke im Museum vaterländischer Altertümer zu Stockholm*, 1913, Heft I, Plates v and vi years implements, symbols, and inventions—useful, religious, or artistic—slowly found their way westward and northward; from eastern Asia to Sweden, a distance which, thanks to the telephone, is today spanned in a few seconds. For example, copper is said to have been used at Anau, Turkestan, about 4000 B.C., and first appears in Scandinavia 1500 years later—namely, 2500 B.C. The Age of Bronze, which was in full sway in Egypt and Chaldea by 3000 B.C., makes its first appearance in Sweden eight hundred years later.

Thus within a period of eight thousand years our ancestors arrived in Scandinavia and passed through a long hunting stage of evolution with only flint implements; through all the Neolithic phases; through a superb development both of the art of flint and of bronze; into the culminating period of the Age of Iron.

Courtesy of Dr. M. C. Ihlseng

The Viking ship, which was discovered—together with weapons and other relics—in the 'blue clay' deposits at Gokstad, Norway, and is now in the museum of the University of Kristiania

Right insert: Discovery site. Left insert: Restoration

"THE PASSING OF THE GREAT RACE"—A REVIEW*

BY

WILLIAM K. GREGORY[1]

FOR many years past the potent labors of Mr. Madison Grant have contributed widely to arouse his fellow countrymen to well-organized efforts, in order to save from extermination the bison, the giant redwood, and other noble products of American evolution. Similarly in *The Passing of the Great Race* he calls upon them to defend and conserve what he regards as the greatest of all human races (the Nordic), which has been long decimated by fratricidal wars and weakened by race mixtures and is now being rapidly outbred by hordes of immigrants from southeastern Europe and Asia. Simply by its own inherent force this book has stimulated anthropological investigation, aroused widespread interest in the subject of race, and given a powerful impetus to the eugenics movement in this country and abroad; finally it has unquestionably influenced the Congress of the United States, which has recently adopted restrictive measures against indiscriminate immigration.

In the earlier editions of this work even the favorably disposed reader could not escape the impression that it was too largely an *ex parte* statement of the case. A surprisingly large number of far-reaching generalizations were made with scant indication of the evidence upon which they rested. Of the Mediterranean race, for example, it was said: "The mental characteristics of the Mediterranean race are well known, and this race, while inferior in bodily stamina to both the Nordic and the Alpine, is probably the superior of both, certainly of the Alpine, in intellectual attainments. In the field of art its superiority to both the other European races is unquestioned, although in literature and in scientific research and discovery the Nordics far excel it." The Alpine race received slight consideration, as a race of peasants and tillers of the soil, everywhere exploited and organized by the Nordics. To the Nordic race was attributed a great preëminence in personal prowess, in leadership, in military genius, in chivalry, gentleness, and nobility. No doubt those who were familiar with Ripley's *The Races of Europe*, were not altogether unprepared for these conclusions, but in default of more detailed evidence for the assertions made it was easy for the skeptic to dismiss *The Passing of the Great Race*, while those who deny the predominant part of heredity in human behavior and attribute everything to environment remained outwardly unmoved by the author's *tour de force*.

Thus both the defenders and the critics of the book joined in a demand for authorities, for a more detailed presentation of the evidence. The addition of a lengthy documentary supplement to the fourth revised edition, and the expansion of the bibliography and of the excellent index, go far toward meeting this legitimate demand, and will add greatly to the authority and reputation of the work.

This documentary supplement, together with the bibliography and index, comprises some 201 pages as compared with 273 pages occupied by the text; it therefore nearly doubles the size of the work and for the first time enables the general reader to form an independent judgment as to the validity of the author's conclusions. The fullness of the index may be judged from the fact that

The Passing of the Great Race or The Racial Basis of European History, by Madison Grant; Fourth Revised Edition; with a Documentary Supplement. With Prefaces by Henry Fairfield Osborn. Charles Scribner's Sons, New York, 1921. pp. i-xxxiii, 1-476.

[1]Curator of Comparative Anatomy, American Museum, Secretary of the Galton Society.

under "Alpine race" we find about 160 carefully classified references, and under "Nordic" about 3 columns.

A few examples of the way in which statements in the text are supported by citations of authorities in the documentary supplement may now be given. On page 158 of the text we find the following statement: "In Greece the Mediterranean Pelasgians speaking a non-Aryan tongue were conquered by the Nordic Achæans." In the documentary supplement we find more than two pages of citations and authorities in support of the assertion that the Pelasgians were Mediterraneans and the conquering Achæans Nordics. The indirect evidence that Pelasgian was a non-Aryan tongue is also given. Incidentally the author's statement (p. 160) that the splendid civilization of Hellas was due to a fusion of the two elements, the Achæan and Hellene of Nordic and the Pelasgian of Mediterranean race, is not inconsistent with his contention that sooner or later the "lower" race will outbreed and replace the "higher."

The author pays special attention to the Aryan-speaking invaders of India, who introduced and imposed their language upon the Anaryan and largely Mediterranean aborigines. He cites authorities tending to show that the Sacæ, who invaded India, were a blond race that has left distinct traces among the modern Tadjiks; that they were also related to the Aryan-speaking, dolichocephalic blonds who invaded Persia and organized the Persian empire.

The author carefully analyzes a great deal of historical data in support of his conclusion that the primitive home of the Nordics was the grasslands and steppes of Russia, extending north of the Caucasus Mountains and the Caspian Sea to ancient Bactria, now Turkestan, and that later the Nordics spread westward into Europe, south into Persia, southeast into India, and even as far east as Mongolia. He is at great pains to identify the primitive Nordics with the Proto-Aryans and to show that the great diversity of the Aryan languages is partly due to their being imposed by Nordics upon Alpines and Mediterraneans originally speaking Anaryan tongues. His notes upon the Neolithic age and upon the Bronze and Iron cultures are especially full and detailed. He identifies the Bronze culture with the Alpines, who spread widely over central Europe and were in turn overlaid by the expanding Nordics. The latter in early historic times appropriated the use of iron from Alpine Hittites (p. 129): "Bronze weapons and the later iron ones proved in the hands of these northern barbarians to be of terrible effectiveness. With these metal swords in their grasp, the Nordics conquered the Alpines of central Europe and then suddenly entered the ancient world as raiders and destroyers of cities. The classic civilization of the northern coasts of the Mediterranean Sea fell, one after another, before the 'Furor Normanorum,' just as two thousand years later the provinces of Rome were devastated by the last great flood of the Nordics from beyond the Alps." (Pp. 129, 130).

But the Alpines and the Mediterraneans are now having their revenge. "The resurgence of inferior races and classes throughout not merely Europe but the world is evident in every dispatch from Egypt, Ireland, Poland, Rumania, India, and Mexico. It is called nationalism, patriotism, freedom and other high-sounding names, but it is everywhere the phenomenon of the long-suppressed, conquered, servile classes rising against the master race." (p. XXXI). In this case the danger, the author concludes, is from within and not from without. "Neither the black, nor the brown, nor the yellow, nor the red, will conquer the white in battle. But if the valuable elements in the Nordic race mix with inferior strains or die out through race suicide, then the citadel of civilization will fall for mere lack of defenders."

NATURE AS THE UNIVERSAL TEACHER

BY

THORNTON W. BURGESS

NATURE was the first teacher of the human race. With this statement no one can take issue. It was not until our prehistoric ancestors began to observe the workings of nature and tried to discover the laws governing the manifestations which they observed, that they began to rise above the animals surrounding them. Every upward step since is traceable directly to increased knowledge of the laws governing life, and these laws are the laws of nature and have existed from the beginning. Nature was the first teacher and still is the universal teacher.

This being true, it seems to me a fatal defect in our present educational systems that nature study is given so small a part. In the curriculum of the average public school nature study has such a minor place that it becomes almost negligible. Yet it should be the foundation on which the educational system is based.

This statement is broad and I am aware that it is likely to be vigorously challenged. Nevertheless, in my own mind there is not a shadow of doubt that it is true. I make the statement out of an extended experience as a writer of nature stories for children, an experience which is constantly driving home to me the fact that in the study of nature lies the key to the most successful mental, moral, and spiritual development of the child.

When I began writing animal stories for children, it was with the sole purpose of teaching the facts about the forms of animal life most familiar to American children. I endeavored to do this by stimulating the imagination, which is the birthright of every child, at the same time holding absolutely to the truth so far as the facts concerning the subject of each story were concerned. As the stories grew in number, surprising discoveries were made.

The first of these was the universal interest in animals and birds. It is not confined to children. I question if there is another subject which can even approach animal life in universal appeal to young and old. Whether the child be of the country or the city, he or she is at once interested by animals. This interest is instinctive. It goes back to the day of the "dawn man." By force of circumstances his sole interest in life must have been in the animals and other creatures surrounding him. His very existence depended on constant observation of them. Such intelligence as he had was constantly concerned with them. The larger forms were an ever present menace to his existence and the lesser forms were his chief source of food supply. This interest has persisted ever since, and probably always will persist.

The second discovery was that nature study is unequaled as a vehicle for conveying information of all kinds. The driest of facts if embedded in a nature story written so as to appeal to the imagination will not only be unhesitatingly accepted but will be permanently retained. Let me illustrate.

During the war when the thrift and war savings stamps were introduced, I was appealed to by a local committee for aid in interesting the school children in buying these stamps. They had not taken hold well in the schools of my city. Patriotism and thrift were the only appeals. Thrift is a dry subject at best even to the adult mind. I wrote a series of stories of Happy Jack Squirrel, the thriftiest of animals, and how he formed a Thrift Club in the Green Forest to which only such of his neighbors as laid up food for future use and thus were thrifty could belong. Peter Rabbit, happy-go-lucky and thriftless, wanted to become a member, and in his misdirected endeavors to be thrifty made plain even to the smallest child the difference between thrift and thriftlessness. Happy Jack Thrift Clubs immediately sprang up in every school. There were Happy Jack parades, plays, and other activities. The relation of thrift to patriotism was so obvious that no child could miss it. The success of the plan was immediate. The idea was taken up by the state committee and later spread to other states.

Thrift in itself was dry and uninteresting. Happy Jack Squirrel and Peter Rabbit were living characters and therefore of interest to the children. The stories woven around them appealed to the imagination. Subconsciously the children refused to admit to themselves that the little living characters of these stories were wiser than they.

Right there lies the psychology of the animal or nature story as an educational medium. Intuitively the smallest child is conscious that it is superior to any animal. It knows that it is a higher being. No child will admit that any animal knows more than he does, and this is especially true in regard to the smaller animals. Much as the adult looks down to the level of the child, the child in turn looks down on the level of the squirrel and the rabbit.

This attitude has been singularly illustrated in the matter of moral lessons. The old-time story with an obvious moral aimed at the reader will not be read by the average child of today. The child has no greater liking for a preachment than the average adult. A story containing an obvious moral and centering around human characters immediately becomes personal. There is instant recognition that that moral is intended for the reader. It is resented.

On the other hand an animal story may have a moral introduced in the very beginning without giving the slightest offense. I have written hundreds of animal stories, each with a conspicuous moral, without bringing a single protest from my readers. Yet should I write one of these stories with no change whatever save of substituting human characters for the animal characters, the story would not be read. The psychology of it is that those morals are pointed at the animal characters and not at the children. The latter not only do not resent those morals but heartily approve of them. If Peter Rabbit has done that which is wrong or foolish, they desire that he should be taught his lesson. Unconsciously they absorb these morals themselves as I have abundant proof in very many letters from teachers and parents.

I had at one time written a series of stories concerning Jerry Muskrat and the building of his house. I was at some pains to explain that provision is made in the roof of the house for the foul air to escape from the interior and fresh air to enter. At the time of writing I had no thought save that of explaining how Jerry builds his house. Immediately after publication I received a letter from a mother who stated that she had a small boy with whom she had had no end of difficulty because he objected to leaving his window open at night in cold weather. He had whined and cried and complained of being cold despite plenty of bed clothes. "It is one thing," she wrote, "for me to tell him that fresh air is necessary and that he *must* keep his window open. It is entirely another thing for me to read him the stories of Jerry Muskrat and how he provides for fresh air in his bedroom. Now my small boy refuses to go to bed unless he has the window open because if fresh air is good for Jerry Muskrat, it is good for him."

That boy would not admit that a muskrat knew more than he did.

A similar incident concerned a child who had a great fear of the dark. No amount of argument on the part of the parent succeeded in effecting a cure. It was accomplished, however, through a series of stories of timid little animals who find the dark friendly. All fear vanished.

Country boys have written me that

they have given up trapping. To these boys trapping meant not only a genuine source of pleasure but a source of needed income. No one asked them to give up trapping. In none of my work had I ever asked boys to give up trapping. But I had used a series of stories in which were told the experiences of Jerry Muskrat and Billy Mink with traps.

By the simple expedient of giving these animals names they became personalities. From their own knowledge of the habits of these animals the boys recognized that the stories were true. They were not the experiences of any one particular muskrat or mink, but of all muskrats and minks. The moment these animals were given personality they became a part of the world of these boys and infinitely more interesting alive than dead. Furthermore, the sense of justice which is inherent in every boy was aroused, and that instant the desire to add to the sufferings and difficulties of the animals ceased.

It is as natural for the average boy to throw a stone at a bird or to chase a rabbit or squirrel as it is for him to draw his breath. He still is a little savage. To tell him that it is wrong and cruel is a waste of breath. Kindness and mercy cannot be implanted from without. They must spring from within. But in that same average boy is inherent a peculiarly strong sense of justice. Arouse his interest in the daily lives of the lesser creatures and that sense of justice is at once aroused. He at once becomes their friend and champion.

The lives of our four-footed and feathered neighbors run parallel to our own. What we experience they experience, only in lesser degree. Keeping this in mind together with the fact that the child intuitively understands and recognizes his superiority, it becomes a simple matter to convey to the child any desired lesson through the medium of a story concerning a member of the lesser orders. But always there must be rigid adherence to truth and fact in regard to these characters. It is because the child recognizes that the stories are true in all essentials that the lesson is at once taken home. Thus the story that humanizes the animal to the point of the impossible is bound to fail in its purpose from an educational standpoint. It is permissible for Peter Rabbit to talk because the child understands that in all probability there is some form of communication between animals. But it is not permissible for Peter Rabbit to climb a tree or to ride a bicycle. The child instantly senses the lack of truth and this of necessity weakens any lesson which the story may seek to convey.

I have at various times on request written stories to emphasize the need of personal hygiene, the obligations of neighborliness, the necessity of fire prevention, the importance of safety first, the rules of health, the necessity of honesty, and many other subjects which at first thought seem far removed from nature stories. But they are not. There is little affecting human life which has not an analogy in the lives of the lower orders. It is because of this and my conviction of the universal interest in animals plus the universal attitude of the child mind in regard to its superiority that I am convinced of the truth of the premise of my earlier statement that nature study should be the foundation of all education.

The child mind is colorful. Dry facts make no impression. The young mind cannot retain that in which it has no interest. Present those facts in such a way that the imagination may seize upon them and they will be impressed upon the memory forever. Nature presents an interest which is inherent. It remains but to capitalize this by presenting that which it is desired to impart in such form that the imagination becomes but a setting for the truth.

Nature study should begin in the kindergarten and progress step by step through all the grades. Instead of the secondary subject which it now is, it should be a primary subject. It will, above all subjects, create the love of truth and beauty without which the life of the individual is starved no matter to what heights of learning he may attain.

BIRDS OF THE WORLD*

AT THE beginning of the year 1914 there were in course of publication abroad two systematic works on the birds of the world—the *Tierreich* and the *Genera Avium*. The publication of these works was interrupted by the World War and in the past seven years no further parts have appeared.

The *Tierreich*, written in German, furnishes detailed descriptions of every species, and is illustrated with a scattering of small text figures of structural features. The *Genera Avium*, on the other hand, is in English and differs materially in method of treatment. The species are not described in detail but may be identified by means of keys, generic and specific. Each family is introduced with descriptive matter and all genera are diagnosed.

Twenty-six parts of quarto size have been issued, each devoted to a single and for the most part small family, the largest being that of the Paridæ (titmice), which occupies eighty-four pages. Eight passerine families, six picarian, five of parrots, and six of the lower groups have been completed.

Each part is illustrated with from one to six colored plates. One or more typical forms of each family is figured, with heads of representative genera or species and frequently also the feet, wings, and tail. These plates are useful aids in identification, notably in the genus *Casuarius*, of which the heads of thirteen of the principal forms are figured.

Ten authors, including most of the more prominent European ornithologists, several now deceased, have contributed to this work. As is usually the case with works of divided authorship, the treatment is somewhat uneven. This is evident in the description of family characters, which in some cases are much more extended than in others. This, however, is a minor defect and does not impair the great practical usefulness of the *Genera Avium* as a work of reference for the general student as well as for the professional ornithologist. It is to be hoped that the publication of the *Genera Avium*, as well as that of the *Tierreich*, may soon be resumed.

WALDRON DEWITT MILLER.

*A Review of *Genera Avium*, edited by P. Wytsman, Brussels. Parts 1–26, (1905–1914).

The land on one side of the children's garden house is devoted to ornamental planting. Various kinds of shrubs, easy to raise in the back yards of Brooklyn, are found here. These shrubs, as indicated by the wooden markers, are the gifts of mothers' clubs and of individuals. Many a person comes here to jot down notes on the growth, habit, and appearance of the shrub he has decided to plant on his own home grounds

GARDENING AND THE CITY CHILD

HOW YOUNG LIVES ARE ENRICHED THROUGH THE CARE AND STUDY OF PLANTS AT THE BROOKLYN BOTANIC GARDEN

BY

ELLEN EDDY SHAW*

"The one or two who hold earth's coin of less account than fairy gold,
Their treasure not the spoil of crowns and kings,
But the dim beauty of the heart of things."

TO UNCOVER this treasure of the heart of nature and to unfold before the eyes those things in our everyday life which are indeed beautiful but which are often passed by unseen,—these are the keynotes of the work done for children at the Brooklyn Botanic Garden. This Garden was started about ten years ago, when approximately fifty acres of land were set apart for the purpose by Greater New York.

At the very outset it was decided that a department of public instruction should be established on the same basis as the departments of scientific research. This would not seem quite so radical a thing today as it did ten years ago. The popular education which the botanic gardens of the world have given heretofore, has, for the most part, been a side issue. To those in charge of this new garden it seemed as important to train children of the city in the appreciation of what plant life adds to daily life, both æsthetically and economically, as it did to establish research departments for the benefit of the scientific and agricultural world. The stated aim of the Brooklyn Botanic Garden is, "For the advancement and diffusion of a knowledge and love of plants." In harmony with this aim, it appeared to the director, Dr. C.

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Stuart Gager, that the opening up of the mind of the child to a vision of the great plant world, the marvelous revelations of nature, our everyday dependence on plants and plant products, the industrial importance of plants, the necessity for raising plants and increasing their number in our city and our world was not only a real contribution to education but would also lay substantial foundations for botanical science. To this end and in order to make the work of real helpfulness to the schools of the borough, it seemed the part of wisdom to plan the activities along such lines as might supplement and enrich the work of the schools in nature study, geography, and high school botany.

For the conduct of our work we have two classrooms equipped for lantern projection and provided with a demonstration table; three children's greenhouses; a house containing useful plants from the tropics and subtropics; the general conservatories; the general plantations, including a native wild-flower garden, rock garden, economic garden, Japanese garden, ecological garden, and other sections; a children's garden and children's building; a room for the Boys' and Girls' Club; and an auditorium seating about 570 persons and equipped with a stereopticon and motion picture machine.

During the spring and fall of each year, even from the very inception of the undertaking, boys and girls of the borough have been coming to the Garden in school hours with their teachers. It may be that they wish to study some common trees. If so, you will see them go not only to the auditorium to look at illustrations of such trees, but also out to the grounds in small groups to examine the trees themselves. Or they may have come to get acquainted with the wild flowers, finding the opportunity of doing so in our wild-flower garden, where are grown species found within one hundred miles of Brooklyn. A little incident suggests itself in this connection. A number of pupils from Public School 66 were visiting the Garden. This school, located in a congested section of the city, is made up of children whose opportunities to get out and see real wild flowers are so limited that a wild flower to most of them means a rose or a lily, but rarely to any one of them a real wild flower like those that the country boys and girls gather in the fields and along the brookside every year from early childhood. These school children, one hundred or more in number, came across the city to learn something about the spring wild flowers. They entered the auditorium, one group lagging very much behind the others. Upon inquiry, I found that this group consisted of underfed and undernourished children, who were not to be hurried at all during their walk around the grounds. In the auditorium we showed them slides of perhaps twenty wild flowers, just everyday wild flowers such as most of us think every one ought to know. We had the specimens on tables for them to see as they marched slowly around. The specimens were then packed up in boxes ready to go back to the school, and the little group wound its slow way about the grounds to see as many of the flowers as possible which were blooming in the wild-flower garden.

The same group came back to us a week later to learn how nature disperses her seed, and when I said to a teacher, "It seems to me that such a trip as this can mean very little to these children," she replied, "You might think that, but it is not so. You should have heard these children talking in the basement during play period about the different flowers they had seen, and you would be surprised to know how clear an image remained in their minds." It was a member of that same little group of under-nourished children who came back to me as her schoolmates were leaving the building. Looking out over the grounds she said, "May I bring my father here?" "Yes." "May I bring my mother here?" "Yes." "May

The educational "movies" shown at the Botanic Garden are well attended by children. Thirteen classes, representing as many schools, are here seen wending their way from the building at the conclusion of an entertainment. Three classes just filled the auditorium. "Movie days" are great days. The children come by invitation and wear their best clothes. They bring their class banners. The different elementary schools supply the music. Sometimes this music is rendered by a talented young violinist; sometimes a whole orchestra participates. A delegate from each school tells all the other children in the auditorium the name of the school that he and his classmates represent and some little point of interest about the school

Visiting classes studying lilies in the new pools. Without the necessity of traveling to the country, these children find at the Botanic Garden water plants that are growing under natural and normal conditions mother bring the baby?" "Yes." She drew a long breath and sighed, "It's just like heaven."

It is not from the poor sections alone that we draw our visiting classes; they come from all sections of the city, from all the schools, the private as well as the public ones. We have tried from the very beginning to establish in the minds of the public this fact: that our educational work is not for the poor alone, nor for the rich alone, nor for the middle class, but for all classes and conditions of children.

Many classes from the upper grades of the elementary schools come for subjects which bear directly on their work in geography, such as coffee culture in South America, forestry, or what plants mean to the world's commerce. The lectures on plants used in industry are readily elucidated by the specimens we have always on hand growing in our economic greenhouse; entering this greenhouse the children are transported from Brooklyn into the tropical and semi-tropical regions where the banana plants grow and bear fruit, and where coffee trees and tea plants may be seen. The rope-making plants (sisal and Manila hemp), the citrus fruits, the fig, the bamboo, sugar cane, rubber plants, vanilla, and plants of the desert—all these are growing here for us to look at.

On Saturday mornings and after school from October 1 until the middle of April classes of boys, and of girls, too, are at work in the children's greenhouses, learning how to plant bulbs, make cuttings, repot plants, and start seedlings for their outdoor gardens

No class ever comes for our lectures on plants and other nature topics without taking away from the Garden some potted plant, which is presented either for classroom decoration or for experimentation. These gift plants measure the zeal of our older boys and girls, for the most part high-school students, who come back to the Garden in small groups once every week throughout the spring and fall to care for, plant, repot, and keep in condition this gift material. We gave away in this manner, during the past year, more than 1500 plants.

We have regular classes on Saturdays and after school. These classes are held in two series, one in the spring and one in the fall. The fall work covers such subjects as the planting of bulbs, the making of cuttings, the repotting of house plants, and the making of wicker containers for plants. The spring work consists largely of starting seedling plants for the vegetable garden, the flower garden, and the window garden. In this course of instruction, which includes from five to eight lessons, each child pays the small fee of fifteen cents to cover the cost of the materials that he carries away with him. Often the question is raised whether some children do not find it impossible to pay this fee. The reply is in question form: how many children have you seen in the city who could not go to the movies or buy gum and candy? In connection with the charges, ranging from twenty-five to fifty cents, made for the rental of plots in our outdoor garden, we have known of only two instances of inability to pay. In such cases we arrange to have the children earn the sum by assisting in our work. Usually the number of pupils in an indoor after-school class is limited to twenty, but occasionally we have had from twenty-four to thirty children. More cannot be admitted because of the limitations of space in the greenhouse visited.

It is interesting to go into the children's greenhouses on a Saturday morning and see each house filled with youngsters working away at the benches. Perhaps in one house a teacher is demonstrating how to make cuttings, and the boys and girls are earnestly working with old stock plants of geranium, dusty miller, coleus, ivy, and mesembryanthemum, making cuttings which will be just right in length, in the method of cutting, and in the amount of leaf surface for evaporation. Do we teach them scientific names of plants? Sometimes, not always. Many of the plants have no common names, and a word like mesembryanthemum or chrysanthemum is probably no harder to hold in mind than are the words Mediterranean or Cinderella. The children that attend these Saturday morning and after-school classes come of their own volition, introduced by a friend, a teacher, or a parent. These classes are not made up solely of children of the neighborhood. The Saturday classes, for instance, include children from the entire borough, and we have even had children from Queens, Manhattan, and Richmond. In school time, too, work of this nature is given. Children come with their teachers from elementary schools for four or five successive weeks to take courses in plant propagation.

Our outdoor garden covers about three-quarters of an acre and last year a crop worth more than $3,220 was taken out of it. Children pay twenty-five cents for an 8 x 10 ft. plot during the six months' period of instruction. This is the area allotted to beginners and sometimes to second or third year pupils who need to go over the lessons which come in the first year's work. Thirty-five cents is paid for an 8 x 12 ft. plot, and fifty cents for a 12 x 18 ft. plot. The boys and girls having these larger plots make their own plans, determine the proper crops for succession and recropping, and make a more advanced study of gardening. The fee covers the cost of the seed which the children use; the crop belongs to the child. A crop record is kept, and a good gardener, on an 8 x 10 ft. plot,

At the beginning of the outdoor season, the children all march down into the garden for their first day of planting. Old Glory is carried ahead. In the garden the markers, garden lines, and stakes are placed ready. This saves time. Note the big boys stationed here and there. They are called garden assistants and do a great deal of work with the younger children

raises in one season a crop worth from \$7 to \$10. The crop produced by some of the younger children working a similar area sometimes does not exceed \$5. The ages of the children vary from eight to eighteen years. Some of the older boys and girls of high school age are called garden assistants and give a great deal of help to the younger children. In fact, we have found that these boys and girls are doing much in their own communities to further interest in outdoor gardens.

We try to make the garden educationally worth while. The fact that we had an astounding crop this past season does not mean that we strove for such an abundance; our aim was to have good work based on sound principles. There are other lessons in our garden besides the raising of vegetables. In the summer, you must arrive at eight o'clock in the morning, or a little before, if you expect to be ahead of the boys and girls. You enter the garden through twin white gates under a rose-arch. You then stroll up the red brick walk until you come to a little white house with green blinds. In front of the door is a brick platform and over the door is the following couplet:

> He is happiest who hath power
> To gather wisdom from a flower.

Through the opened door you step into the room where we gather and talk over our problems of the garden and of life. Connected with this room on the left is a girls' cloak room and on the right are similar accommodations for the boys. Upon entering the house the children go directly to an oak table, look over some sheets, and make a check mark against the number of their garden therein recorded, thus indicating that they have attended that day. They then go out through a central door to our tool room —the house is really a glorified tool house —which is always in apple-pie order unless it is a muddy or wet day, and then the house committee is constantly cleaning up so that it may be in good shape. Our tools are arranged about the wall; in little cubby-holes you will see the trowels, the measuring lines, and the pointed sticks which the children use to make the drills when planting seed. There are also bottles of seed from which the teachers give out the necessary amount for the day. The boys and girls do not linger here, but go straight out the back door to the bulletin board, where they read what tools they will need for the day's work. It may be a day when we are cultivating our gardens, and hoes or hoe-rakes are required; or it may be that worms are appearing on the carrots and that the bulletin board has something to say about that. After selecting the tools needed, the children go into the garden and report to the teacher assigned to the special section. This teacher then looks over the individual plots and explains the work for that day.

In no two cases after the first planting do the plots look alike. One of the things which will come out of a piece of garden work is this: that your sins will surely find you out. If a person plans carelessly, his crop comes up in just such a way; if he fails to thin as he has been taught to do, his crop is bound to be inferior to that of the student who has thinned properly. The mistakes of the individual appear right on the face of the garden, and it is by recognizing these mistakes and resolving to avoid them in the future that we gain in power to do our work well. Beginners in our outdoor garden have a planting plan which has been given them during their indoor work. No boy or girl may have a plot who has not attended our spring garden courses, because in these courses we take up the principles of our outdoor garden work, make our plans, and learn to know our seeds.

Just as soon as the first crop comes out of the garden, and that first crop will of

A group of older girls gathering in a harvest of vegetables. These girls come to the Garden from the Brooklyn Training School for Girls. They have a community plot and raise vegetables enough to be of real help in supplying the table at home course be radish, the child has a choice of certain seed he may put in the earth for a second crop. He chooses according to what mother and father like. We try to link the home life as closely as possible with our work. After a child has been two seasons in the outdoor garden, and sometimes after one season, he is ready to plan his own garden under direction. Matters are discussed, plant families are considered, the type of vegetable—whether it is a leaf, root, or stem crop—is determined upon, and then the plans are drawn up at home and brought to us for inspection. Sometimes a plan will appear on an old paper bag because no better material is available at home. One boy, apparently not knowing how to draw to scale, brought a plan on a piece of paper the length and size of his plot! It was highly amusing but rather awkward, since the boys and girls carry these plans right into the garden with them and do their planting from them. The older boys and girls make much more pretentious plans than the younger and are very keen in using to best advantage the space allotted to them. Many questions arise in regard to insect pests, common weeds, soil experiments. Around the little garden house a variety of shrubs have been planted: shrubs that are easily raised, that blossom early and late; that have bright berries which will last all through the winter. You might happen to visit us on a day when you would see boys and girls in and out among the shrubbery with notebooks and pencils, making drawings of types of leaves, studying the blossoms, learning all they can about the shrubs. These shrubs are for the most part gifts of the kindergarten mothers' clubs of various city schools.

The formal flower garden with its sundial, the present of one of the teachers' training classes of the Botanic Garden, is another spot of interest to the children as well as to visitors. More and more we are putting perennials into this garden and keeping our annuals for our picking garden. The perennials have been raised from seedlings by the children in the greenhouses. In fact, this garden represents the boys and girls. The little rose garden is to be a memorial garden to those boys and girls who have been with us awhile and all too soon have left us.

Once when speaking in one of the largest schools on the lower East Side of Manhattan I told the children of the little white house, the rose-arch, the brick walk, the flowers, the little vegetable plots, the motto over the house door, and then asked them of what it made them think. Two thousand boys and girls spoke as one, saying the single word, "Home." Yet those children lived under the poorest of conditions; their dingy tenements were devoid of lovely rose-arches and blossoming flowers: notwithstanding, such a picture seemed to them typical of home. So a part of real educational work is to implant in the minds of children the desire for things that are attainable, and to stir up that which pushes all of us on, a vivid imagination.

One year we had in our garden a most interesting little group of boys who had to walk several miles across the borough to come to their work. One boy was appointed captain and he told me that he started on his rounds at five o'clock in the morning waking his friends, making them have their breakfasts, and then marshalling his little troop across the city.

The boys and girls of our summer garden work not for the garden alone but in different forms, and in various ways plan something in the interest of the community. Some years the children have contributed vegetables once a week, to be carried in baskets to homes, orphanages, or hospitals. One season, during the war, we sent flowers every week to a hospital where tubercular sailors were being cared for. We felt that it was our duty and pleasure on that particular day to make sure that, regardless of weather, flowers went to the hospital. I can remember rainy days when the boys would go out in two's, one holding an umbrella while another picked the flowers. Gay little messages went back and forth between the sailors and our boys and girls. At the beginning of the season we were sending flowers to thirty sailors in that hospital; at the end there were only two left whom we could cheer in this way. The others had gone "westward."

The boys and girls who come to our garden and to our indoor classes form what is called the Brooklyn Botanic Garden Boys' and Girls' Club. The members usually meet four times a year in the auditorium of the Botanic Garden building. The most interesting part of the programme consists of the speeches, for sooner or later all these young people must address the club on some subject of garden and plant interest. They have special topics in which they prepare themselves over a period of six months or a year. Such subjects as the following are representative: common trees in Prospect Park; good flowers to have in a garden; different methods of testing seeds; bagworms and the destructive work they are doing on the trees of our city. We call this research work, a great and dignified name which makes all the participants feel the importance of really doing their best. They value the opportunity to stand on their feet and discuss what they have learned.

All summer long the children pick flowers in the formal flower garden and every week each child has a bouquet to carry home to mother. The poplars in the background act not only as a windbreak, but as a screen, shutting out unpleasant sights and enclosing the children in what they regard as their own little home grounds

The last of September boys and girls come from all over the city bringing to our annual children's garden exhibit those plants which they have raised either in school or home gardens. Some schools send big automobile trucks containing their exhibits. Others charter a local team, or even ask a good-natured baker, expressman, or anyone interested in their work for the use of his conveyance. Some of the exhibits are pathetic. Some of them are remarkable. No exhibits may be entered from our own garden.

The children's garden exhibit has been held every year since our children's work started nearly nine years ago. The first year a most amazing number of old tin cans filled with the strangest-looking plants arrived for display. The plants came in all conditions of decrepitude. Most of them were brought in pushcarts or in the arms of children across the city. One small child carried a pot in which was a common ragweed, evidently tenderly cared for and proudly placed on exhibit as if its owner felt that she had reared the most remarkable plant in the United States. One little boy had a lovely lily in bloom, but when he was taking it from his home to school another boy, who was a subject for constant discipline, came up to him and broke off the flower. The little lad, with lily in hand, went to his principal, crying because the beautiful plant upon which he had centered so much thought and attention was ruined for the exhibit. The principal looked it over, helped him tie the flower on the stem and sent two guards with him to protect him on his way to the exhibit. These seem just little things, but are really big things in the development of character and appreciation. We have raised the standard for entrance to our garden exhibits each year, and the boys and girls know that to qualify they must plan accurately and tend carefully.

One season a very lovely potted nasturtium plant in full bloom took first prize. The aunt of the owner told me the story connected with it, for there is usually a story that goes with each individual exhibit. The lad had cared for his plant all through the hot season at his summer home in New Jersey. When the family were about to return to the city in the fall, the boy told his mother he intended to bring back his plant with him, but she, because of having so much to attend to, said they simply could not attempt it. On the way to the station the boy intimated he had forgotten something and went back. When he rejoined his family, he was carrying his beloved plant. Of course, then his mother did not have the heart to refuse his wish. So it was entered in the exhibit and received first prize. His aunt said that the recognition thus accorded was the first big thing that had ever come to that boy. He had seemed to his parents a rather mediocre scholar, had been outstripped by his brother in all school and home activities; yet all of a sudden he had accomplished a piece of work which in its class was preëminent. Little things and little inspirations point the way to bigger things in the lives of children and lead to real achievements in the larger tasks of the future. We are often asked if we give these courses to help train farmers. Our reply is always the same: we give them to help train men and women.

Our educational work is not confined to children. Courses are offered for teachers, some of which count toward advancement in the city public school system and for college credits. These courses are given after school and, with the exception of a few short courses, cover a period of thirty weeks. In certain years the Botanic Garden has conducted a short summer session for teachers so that in a very limited time some experience may be acquired by a teacher in work with children in the outdoor garden. The practical work done in the field is almost entirely along the lines of plant identification, tree study, and to some extent, control of injurious insects.

Extension courses are given for teachers of children's gardening and nature study. These courses are so arranged that they emphasize not only the theory of each subject but also its actual practice in classroom, greenhouse, garden, or field. At the same time the work is correlated to meet the needs of each grade of the elementary school.

Since figures often are enlightening and convincing, this statistical report may be in order. During 1921 the attendance was as follows:

In regular garden classes	24,008
In visiting classes	24,811
At lectures (children and teachers)	14,985
At talks given in schools and clubs	15,581
Total attendance	79,385

Among the elementary schools of Brooklyn 86 per cent have used the Garden; this figure does not include the private schools. All of the high schools have availed themselves of it.

Perhaps the best summing up of the reasons why boys and girls come here was given by a small boy in our outdoor garden, who, when asked why he came to the Botanic Garden, straightened himself up, thought a moment, and then replied: "I am here for three reasons: first, for elementary instruction; second, because I like it; and third, because I get a crop."

Since more than one half of the children of the United States live in the cities and not in the country, more and more it behooves all educational institutions to do their very best to give children something of that background which you and I had when we were children growing up in the country or in communities that did not resemble the congested cities of today. What in later life can equal the experiences enjoyed in the great out-of-doors in early youth? What substitute is there for that first thrill of early spring when the red maple blooms in the swamp, or the pussy willow shows its soft and fuzzy little catkins? What can compensate us if we are deprived of that stroll along the brook, of the opportunity to paddle in the water and to pick wild flowers? Nothing. Our natural history museums, our botanic gardens, and our other public and private institutions, not to mention individuals, must give as a part of their contribution to the background of this generation, all that it is possible to offer in the way of natural surroundings to the children of the cities, so that these children may catch a little of the vision that is gained from nature herself, and catching it, may never lose it.

The little rose-arch through which the children enter the garden

A BIT OF THE SEASIDE TRANSPORTED TO THE SLUMS

The children who visit the nature room in Norfolk Street love their "beach" and examine with interest the shells of varied shape that bring to them a suggestion of the teeming life of the ocean-washed coast

MAKING NATURALISTS IN NORFOLK STREET

BY

MRS. JOHN I. NORTHROP*

NORFOLK Street is in the heart of the congested East Side and anyone who has been there will know that naturalists are the last thing it suggests. Nevertheless there are boys and girls in Norfolk Street who can recognize the common birds and insects, flowers and trees, shells and minerals, and can tell you something about them in spite of the fact that a year ago many of them had never been away from city streets in their lives and scarcely knew such things existed. The miracle has been wrought by the nature room, which was established by the School Nature League in Public School No. 62, 25 Norfolk Street, as related in a former article in this magazine.[1]

Originally a dark, dingy schoolroom on the ground floor, it has been so transfigured with cedar and oak branches, club mosses, bittersweet, smilax, and other woodland treasures that the face of every new visitor invariably lights up with pleased surprise as he crosses the threshold. What wonder that the little dwellers in these squalid streets find it a land of enchantment! "A veritable little garden of Eden," one visitor called it. One of the boys referred to it as "the grandest room I ever saw. Why! the decorations such as fish, trees, nests, birds, shells, and vegetation would bewilder anyone." Another wrote, "The wonderful flowers, beautiful minerals and birds, colored shells, and many other things of nature make me happy when I come to the nature room—I feel just as happy as in a big park."

Naturally the live animals arouse the greatest interest—the aquarium with its fish, newts, tadpoles, and snails; the terrarium with its frogs, toads, Florida lizards, and the always fascinating snake, which the children beg to be allowed to hold in their hands. A box tortoise is a never ending source of surprise, and a pair of guinea pigs always have an admiring audience. Just at present a baby alligator is the star attraction. Of the other exhibits, it is difficult to say which the children like best, the beach with its shells, coral, and starfish; the trays of cool, green moss with growing ferns, partridge berry, and wintergreen; the miniature garden with its cedar-crowned hillock, rocky ledges, pools, and bridges; the tiny desert with its sand and cacti; the birds and their nests; or the plants and flowers. The mineral corner with its mica, lava, fossils, and other attractions is always surrounded by an interested group as are also the mounted animals among the evergreens—porcupine, woodchuck, beaver, and squirrels—and the insect corner with its moths, butterflies, and other six-legged crawlers and fliers. Every exhibit is fully and plainly labelled. Our visitors also take much interest in the Audubon bird charts and in Murrill's mushroom chart. One small girl of six could name every bird on one of the charts, the kingbird being her favorite.

This nature room is filled with interested and happy children most of the time. It is a neighborhood nature room, being visited during school hours by classes with their teachers from ten different schools. There is a certain period allotted to each school, and classes usually make half-hour visits. Some of the teachers tell us their children talk of their prospective visits long in advance and of what they have seen for weeks afterward. I might say incidentally that although the room is visited by from eight hundred to a thousand children every week, and they are allowed to

[1]Natural History, May-June, 1920, pp. 265-276.

*President of the School Nature League of New York City.

FLOWERS DELIGHT THE CHILDREN OF THE LOWER EAST SIDE

In the narrow, brick-walled city streets that bound the lives of these children, there is nothing to remind them of the bright, green world without, but in the nature room they find the fresh growths and soft bloom of the country touch and handle many of the specimens, very rarely is anything lost or broken.

The most interesting times in the nature room are on Tuesday and Thursday afternoons between three and half-past four, when it is thrown open to any child who wants to come in and when older visitors wishing to familiarize themselves with the work of the League are also made welcome. Such free access has been the custom for two years, yet the attendance shows no sign of falling off, averaging about seventy, all that the room can comfortably hold. The children crowd in as soon as the door is open and are loath to leave when closing time comes. They are of all ages, from toddlers of three and four to those of high-school age, but the great majority of our constant visitors are between eight and twelve or thirteen. They find here an open door into a land of enchantment where everything has a story as wonderful as any fairy tale. We show them the marvelous domicile of the trapdoor spider, the little grub in the heart of the gall, the wonder of the branch packed away in the little brown bud, the sleeping pupa in the cocoon, the fossil in the rock. No wonder they say that "everything in the room is like magic."

The nature room of the League is a live, connecting link with the wide world of out-of-doors, the idea being that through this medium the child may at least glimpse the wondrous panorama of the changing year. Therefore, many of our specimens are changed with the seasons: evergreens and cones in winter, budding twigs, sprouting seeds, frog spawn in spring; wild and garden flowers as early and as late as we can get them; fruits, seeds, and vegetables in the fall. Our specimens are not always local. Sometimes kind friends send us treasures from far away. We have had tropical plants, fruits, corals, and shells from Florida, desert plants from Texas and Colorado, cotton and peanuts from South Carolina, and a large and varied exhibit from California. We also post and give out nature poems by Wordsworth, Emerson, Lowell, van Dyke, and others when they are most appropriate.

Many of the children who came each day the room was open were soon quite certain they knew everything in it. They were enthusiastic over our suggestion of testing their knowledge; accordingly, at stated intervals, those who wish are given the opportunity of showing what they know. The labels are removed and the candidates, who must be ten years of age, are taken about the room and requested to point out and name at least three of each of the following: birds, bird nests, insects, branches or leaves, flowers or fruits, shells, and minerals. There is also a written test in which the children must name correctly at least ten out of fifteen miscellaneous specimens chosen from those that have been on exhibition in the room for some time. The children who pass both tests are entitled to wear the button of the League and to be known as junior members, a title of which they are immensely proud. Up to date there are forty-four such members, twenty-nine boys and fifteen girls, and more are preparing for the tests. Two ten-year-old boys who had never been out of the city passed perfect tests after having been to the nature room only six times. This is surely eloquent testimony to the value of visual instruction and also to the eagerness of these children to learn. We have tried to give our junior members further opportunities of seeing and learning. The first twelve were taken to the International Flower Show and we were surprised to see how many flowers among all that bewildering mass of bloom they recognized as having been "in our nature room." Finding that six out of eighteen had never been out of city streets in their whole lives, we arranged an all-day trip to the "real country"; at Woodlands they had their first blissful experience of picking flowers for themselves. We were amazed to see how many trees and flowers they could identify, not only in the field, but from

The mineral collection in the nature room has proved very instructive

the cars. "Pine," "iris" "snowball," "lilac," "white birch," they called out as they passed. They recognized birds they had seen only as stuffed specimens or on a chart, and they knew mica, schist, trap rock, and granite from the small bits in their mineral corner.

During the summer many of the junior members were able to spend at least a week in the country, but nine who were not so fortunate and had never been to the real country were invited, in late October, for a Friday to Monday visit at my farm in the Berkshires. What never-to-be-forgotten experiences they had! One of the boys wrote, "I cannot express how wonderful the surroundings were and how much it led me to think I was in a real fairyland. So I thought while staying there." If any further testimony were needed as to the value of the nature room and what it has put into the lives of these children, the greatest sceptic must have been convinced had he seen them going through the woods and fields, calling out, with the same alert interest as had the children taken to Woodlands, "white pine," "pitch pine," "white oak," "red oak," "scrub oak," "laurel," "club moss," "New York fern," "marginal shield fern," "reindeer lichen," "quartz," etc., and furthermore able in most cases to give the reasons for their identification, and had he also witnessed their unbounded delight in recognizing old friends of the animal world and their eagerness to make new ones. There was only one time when they looked perfectly blank. I had suggested their going out to the chicken house to get the phœbe's nest there. "Come show us," they said, and I suddenly realized that although they would have recognized the phœbe's nest because we had one in the nature room, a chicken house was entirely outside the ken of a Norfolk Street child and not one of my visitors had the faintest idea what to look for.

In November, the junior members, numbering then only about twenty, were taken to the woods near Ardsley where they collected leaves and fruits and rapturously captured a snake, a frog, and a salamander for "our nature room." We have not only taken the children to the woods but we have introduced them to the museums. A number now have the "museum habit" and they are also acquiring the "notebook habit." A small reference library has been installed in the nature room and instead of telling them the names of new specimens, we often send them to the books to find out for themselves. They think that a fine game.

The boys and girls who passed the first test last spring have been eagerly looking forward to a second. Those passing these much more difficult requirements are to be known as young naturalists and they will really deserve the title. To acquire it they must be able to name six animals and at least six specimens in each of the groups of nature previously referred to as against three required in the test for junior membership. In the written test they must name correctly at least twelve out of fifteen specimens, which are to include three ferns, three mosses or lichens, two fungi. They are to make notes on all the "nature" to be found in Seward Park (around the corner from the nature room) and to select some particular tree, make a drawing of it and note everything regarding it they can see. They are to go to the American Museum of Natural History and make a study of one of the following: the New England spring group in the reptile hall, any four permanent bird residents about New York City and their nests, or the marine life in the Woods Hole or Nahant exhibits. They must be able to tell something about the plants and animals in the group selected and everything they can learn from the exhibit itself as to the lives and habits of the animals shown. They must also help some boy or girl prepare for the first test. This they love to do and every afternoon one may notice newcomers to the room being piloted about by junior members and gravely instructed how to distinguish the different evergreens, how to tell the budding twigs apart, what names to give to the shells on the miniature beach and to other objects. The nature note books of the candidates also count in this second test. These were started at our suggestion when the room closed last summer and have been kept up with the greatest interest ever since. Some members have five or six by this time in which they have mounted leaves and flowers, often with notes telling how they may be recognized, small shells, bits of bark, etc., interspersed with pictures, poems, bedtime stories, and articles by naturalists from various papers.

Up to date nineteen children have passed the oral test and instead of naming only six specimens, they wanted to go on and name everything in the room. So far thirteen have passed the written test, two with perfect papers. The specimens

The spell of Mr. B. T. B. Hyde's personality has thrown a charmed circle about these boys, junior members of the School Nature League, who late in October were invited by Mrs. Northrop to spend a week-end at her farm in the Berkshires

they were asked to name were the fruit of the sensitive fern, Christmas and polypody ferns, haircap and white or cushion moss, reindeer lichen, beefsteak fungus and earthstar, a vireo nest, a mounted meadow lark, a beetle, leafless twigs of black birch and garden cherry, lead ore and lava. How many country children between ten and thirteen would know these things?

It is all a most interesting educational experiment. When one remembers that a year ago or even less, the minds of these children, so far as knowledge of nature was concerned, were a blank, it is remarkable that they have been able to absorb so much through these informal visits to the nature room. Better still, it has put a new and absorbing interest in their lives. It would add very greatly to the value of the experiment to take these children who have done such good work in the nature room all winter and give them the opportunity to go on in a nature camp during the summer. If we could take them in groups of twelve or fifteen for a month's stay and let them spend half their time working in individual garden plots, where they would have the joy of making things grow, and the rest of their time in woods and fields learning from nature herself, it is impossible to set bounds to what this might do for these children, physically, mentally, spiritually. If some fairy godmother or godfather will only materialize to help us with the necessary funds and the right kind of a director be found, the League would be glad to organize and carry on such a camp. There is none that we know of on just these lines.

So far I have spoken only of the work

Other occupations of the nine happy youngsters shown in the picture on the opposing page. Their baskets are full of specimens. Mrs. Northrop has offered her farm as a site for the camp which she hopes can be established for the children of the League

of the League in one nature room, that at our headquarters in Norfolk Street, and mainly in relation to its effect on individual children. I would like to call attention to some broader aspects of our work. One of the objects of the School Nature League is "to work for the establishment of a nature room in every school." Up to date we have been instrumental in starting twenty in various parts of the city. Owing to the lack of space, four of these are very small rooms and six others only "nature corners," yet even under these adverse conditions, the testimony is always the same: they are a source of inspiration and a never-ending delight to the children. What might not a spacious, well equipped, well lighted room (on the roof perhaps) mean to a school?

A real nature room such as I have described makes a strong appeal to the child's curiosity, love of beauty, and to his imagination. Instead of being more or less passive recipients of a balanced intellectual ration poured into them in the hope that some of it may be assimilated, the children become eager seekers after knowledge about things in which they are intensely interested. As they throng about the tables, they suggest hungry little animals putting out tentacles in every direction, seizing with avidity on the knowledge they want, and finding learning not a task but a joy. If every school could have a nature room, perhaps not the least of its services might be to make a breach in some of the antiquated, formal, dry-as-dust methods that are still too much in evidence in many of our schools.

Another potent argument for a nature room in every school is that in addition to its main purpose of teaching nature, it can be correlated with many other subjects. It is a great help in geography, supplies specimens for drawing and painting, furnishes endless subjects for compositions, and through the child's interest in the nature poems leads to a real appreciation of literature. A nature room is also a special boon to the ungraded and foreign classes. Experience has shown that it quickens the slow mental processes of the subnormal child and that it helps the newcomers to our shores acquire a vocabulary in a minimum of time and with a maximum of pleasure.

But after all, it is not the knowledge that the nature room is putting in children's heads but what it is putting in their hearts and lives that really matters. A visitor who knew children and knew the schools, after spending an hour in our Norfolk Street room with some of our junior members, said when he left, "I firmly believe those children are getting in your nature room the best things they will get out of their whole school life." Our five years' experience, corroborated by the testimony of teachers and parents, has proved to us that through the nature room we develop a side of the child's nature that other subjects do not touch. We also put in his hand a talisman that may prove a source of joy all his days.

On the civic side I believe that a real nature room would do more to encourage conservation and check vandalism than any other agency. The children learn there to love plants and animals, which means that they will not injure the one nor be cruel to the other. This was impressed upon us when we took our junior members for their first day in the country. Without any admonition or instruction from us, not a flower or a leaf was thrown away; everything they picked was cherished and taken home.

Looked at in the broadest aspect, nature rooms in the schools would surely prove an important factor in starting little currents of population from the congested cities back to our abandoned farms. Our junior members are all longing for a country life and hoping to be gardeners and farmers and naturalists, and doubtless some of them will really attain their wish. With the continually increasing influx cityward, is not any means to stem the tide worth trying? As the result of our five years' experiment we firmly believe that a nature room in every city school would fill a vital need and would prove a source of lasting benefit not only to the child but to the school and to the community.

FEATURES OF THE PROPOSED ROOSEVELT-SEQUOIA NATIONAL PARK

BY

FRANCIS P. FARQUHAR

WHEN the Sequoia National Park was established in 1890 to preserve the giant trees of the Sierra Nevada in California, very little was known of the high mountain region immediately to the eastward. A few mountaineers and explorers had penetrated into the vast cañons of the Kings and Kern rivers and had crossed the principal passes; geologists had hastily inspected the country; and prospectors had tried the rocks for metals and had found them wanting. For the most part the land was given over to sheepherders to be used and ruined without let or hindrance and without fee or tax.

Then two things happened: the people of the San Joaquin Valley, the great central valley of California, whose lands were watered by the streams from the mountains, discovered that the safety of the natural storage at the sources was being threatened by the sheep; and at about the same time the public became aware that hidden in these mountains was some of the finest scenery in the United States. In an article in the *Century Magazine* for November, 1891, John Muir called attention to this splendid region and spoke of the Kings River Cañon as "A rival of Yosemite." He urged that the park boundaries be extended to embrace it and concluded: "Let our law-givers then make haste before it is too late to set apart this surpassingly glorious region for the recreation and well-being of humanity, and all the world will rise up and call them blessed."

Army officers, sent to guard the new park from depredations, reported both the damage done by the sheep and the impression made by the majestic scenery. It is interesting to turn back thirty years and read what Captain Dorst of the Fourth Cavalry had to say in his report to the Secretary of the Interior for the year 1891:

"There has been some talk of the propriety of further extending the park to the eastward to the main divide of the Sierra Nevada range. . . . . But aside from the objects of interest, the prosperity of the population living in the valley between the Sierra Nevada and Coast Range depends upon the preservation of the timber and brushwood in the mountains. . . . Sheep destroy much of this brush and herders often set fire to it in the fall to destroy it, as the ground will furnish a good crop of grass next season. . . . Knowing how much the welfare of a large population depends on this matter, I am in sympathy with any plan that will preserve the mountainous country in its natural state."

Captain Dorst's successor, Captain James Parker, was equally impressed and wrote in his report for 1893:

"By taking in a portion of the forest reserve east of the Sequoia and General Grant National Parks there would be included a country devoid of inhabitants or settlements, without roads, but naturally suited for a game reserve. It would include and preserve the sources of the Kern River, a stream which is much depended on for irrigation. It would reclaim from the sheepmen an area now almost impassable to the traveler, to such an extent is every living thing eaten off the face of the earth and trampled under foot by the hundreds of thousands of sheep which every year roam over that territory. . . . This extension of the park would include what is perhaps the finest fishing ground of America, or of the world, the Kern Lakes and the upper waters of the Kern River. It would include some very picturesque country, notably about Mount Whitney."

Ten years saw a change for the better:

Photographed by Francis P. Farquhar

Milestone Mountain on the Great Western Divide toward the southern extremity of the proposed park is a remarkable tower of splintered granite, the remnant of a higher peak of ages past

Photographed by Ansel F. Hall

Sculptured peaks and cañon walls in the headwaters of the Kaweah River

Photographed by Francis P. Farquhar

Alpine lakes, with the deep blue of stained glass windows, mirror on a still day the calm beauty of the mountains. The lake here shown is at an altitude of 10,500 feet

Photographed by Francis P. Farquhar

Mount Brewer seen from a vantage point near Bullfrog Lake

Photographed by Francis P. Farquhar

THE PALISADES

These splendid ramparts form a mountain barrier along the northeast boundary of the park. They are among the highest peaks in the United States. North Palisade, on the left, attains an elevation of 14,254 feet. Another 250 feet added to its height would make it tower above the loftiest peak in the country, Mount Whitney. On the right is Middle Palisade, 14,049 feet in elevation, which because of its greater proximity appears to outrank its neighbor. The view is taken from Mather Pass

Photographed by Ansel F. Hall

IN THE HIGH SIERRAS

On the left is Mount Needham; the dominating peak on the right is Sawtooth. Although less than 14,000 feet in elevation and therefore not sharing the distinction enjoyed by ten other peaks within the proposed Park, these lofty mountains, seen from Black Rock Pass, offer a majestic spectacle. Three terraced lakes are visible in the picture, their basins appearing like stepping stones for the upward climb of some mountain Titan the sheep menace was removed by regulating the grazing and the wonders of the High Sierra became more widely known; and still the army officers advised the extension of the park boundaries. In 1901 Captain L. C. Andrews of the Fifteenth Cavalry wrote:

"If, on the other hand, it is desired to combine the wonders of nature in this section into a national park to be in the same class with the Yellowstone and Yosemite, this, too, can be done. The canyons and mountains are here as grand, perhaps, as any in the world. Within reasonable distance of the Giant Forest as a central feature, . . . are the Kings River and Kern River canyons, reported to be the deepest in the United States, and Mount Whitney, the highest mountain."

Another decade saw a distinct advance in the knowledge of the country and in the recognition of its value as a national park. Again, in 1911, the army guardian, Major James B. Hughes of the First Cavalry, advocated the extension of the bounds: "Practically all the new territory that would be required is now in the national forest, is of little value commercially, and of great value as a park reserve. Its natural beauties are great and varied, there is comparatively little deeded land within the indicated boundary, it forms a natural game preserve, and within this extensive area game of all kinds should prosper and increase rapidly. . . . Also within this proposed area there are some of the finest trout streams in the world."

In recent years a determined effort has been made to persuade Congress to take action in establishing this greater Sequoia National Park, culminating in the proposal to make it a memorial to the late President Roosevelt. One by one objections have been overcome until at last the way seems almost clear for final success. The sheepmen have been driven from the scene; the cattlemen have become satisfied that they are not seriously affected; the lumbermen find that they have no holdings within the proposed boundaries; the irrigationists see a positive advantage in the additional security of their water supply; the miners have abandoned hope of ever finding anything to mine; the National Forest Service and the National Park Service have come to an agreement as to the proper boundaries; and finally the water power companies have declared themselves out of the field for the reason that they can find no sites that they consider of economic value for this generation at least. The verdict would be unanimous in favor of the enlarged park if it were not for the claims of the municipal power bureau of Los Angeles, whose engineers have gone far afield in search of all possible sites no matter how remote or unpromising. The arguments in favor of their power scheme are so slender and the arguments against it so strong that it is not likely to stand long in the way of a matter of such inestimable benefit to the whole country as the establishment of this great recreational area as a national park. For, after all, this region has a very positive character that is bringing people to it every year in increasing numbers, seeking recreation and inspiration. Here one may live happily out of doors all summer long, giving little thought to protection. Storms are infrequent and of brief duration; the days are neither too hot nor too cold; and the nights, though cool, are rarely chilly. With so few drawbacks there is abundant opportunity for enjoying the attractions of nature, both animate and inanimate.

The scenery offered by the eleven hundred square miles of the proposed park is uniformly magnificent. In the writer's estimation it is unsurpassed in the United States for grandeur of form and for delicacy of texture. It lacks the brilliantly colored rocks of the Yellowstone Cañon or of the cañons of Utah, but the many deep blue, alpine lakes with the blue sky overhead, and myriads of bright wild flowers all about, give color enough to satisfy any mortal. The great cañons of the Kaweah, the Kern, and the Middle and South forks of the Kings; the varied peaks of the Great Western Divide; the rounded heights of the Monarch Divide; the extraordinary domes of Moro Rock and Tehipite; and above all the Sierra crest, extending for miles along the eastern border of the park, present a panorama of indescribable majesty.

A list of mountain altitudes in the United States shows fifty-six peaks over 14,000 feet in elevation. Of these, forty-two are in Colorado, one in Washington, and the other thirteen in California. Ten of the California peaks are within the proposed Roosevelt-Sequoia National Park, including the highest of all, Mount Whitney (14,501), the highest point in the United States outside of Alaska. The others are: North Palisade (14,254), Russell (14,190), Sill (14,100), Split Mountain (14,051), Middle Palisade (14,049), Langley (14,042), Muir (14,025), Tyndall (14,025), and Barnard (14,003). The figures are from the United States Geological Survey topographic maps. Many peaks of slightly less altitude are equally impressive and afford varied opportunities for mountain climbing. Of these the more prominent are the Kaweah Peaks, Brewer, Stanford, King, Gardner, and Goddard.

Camping in the Sierra Nevada invariably produces a thirst for knowledge. One can identify the seasoned camper by the number of branches of natural science in which he is actively interested. At first perhaps geology grips him. He wants to know how the cañons were formed and why the mountain tops are shattered. Then he wants to know how to distinguish the pines or how to name the flowers. He discovers that there are many more animals and birds in the mountains than he at first supposed.

The region is a fascinating field laboratory for the study of geology, particularly in respect to granite structure and the effects of glacial action. Beginning with the work of the California State Geological Survey under Josiah Dwight Whitney in 1864, when William H. Brewer led a field party into the Kings River region, extending through the explorations of John Muir and the critical observations of Grove Karl Gilbert and Andrew C. Lawson, down to the recent topographic work of the United States Geological Survey, this section of the High Sierra has been of unfailing interest to scientists. In 1881 S. P. Langley conducted on the summit of Mount Whitney a series of experiments on solar heat, and in 1909 Mount Whitney was the seat of a meteorological observatory for the Smithsonian Institution.

The High Sierra is not a region of big game. Indeed the number and variety of large animals is comparatively small for such a wild country. The principal game animal is the Rocky Mountain mule deer (*Odocoileus hemionus hemionus*). The Sierra mountain sheep (*Ovis canadensis sierræ*) was undoubtedly common before the domestic sheep and the hunter rendered it almost extinct. A few years ago a small band was seen within the park area and it may be possible to restore this animal to its native slopes. The grizzly bear (*Ursus horribilis californicus*) was once at home here, but he is now completely and inevitably extinct. The black bear (*Ursus americanus altifrontalis*), however, survives, for he is able to get along better with his neighbors. Fast going the way of the grizzly is the mountain lion or cougar (*Felis oregonensis oregonensis*). The lynx or wild cat (*Lynx eremicus californicus*) is also found, but is not much in evidence. The large mountain coyote (*Canis latrans lestes*) is here and is sometimes mistaken for a wolf. There are no wolves in the Sierra, however. The High Sierra red fox (*Vulpes necator*) is found on the Kern plateaus.

The lesser mammals are more abundant. Squirrels, chipmunks, chickarees, and ground squirrels are ubiquitous. The Sierra marmot (*Marmota flaviventer*) is common in the rock piles at the stream sources. He has a very interesting neighbor in the cony or pika (*Ochotona albatus*). Another interesting animal is the Sierra snowshoe rabbit (*Lepus campestris sierræ*). Martens, weasels, badgers, fishers, skunks, and wolverines are natives of the region.

Many common birds are found, but even a list would be too long here. The most distinctive of the conspicuous birds are: the golden eagle (*Aquila chrysaëtos*), the Clark nutcracker (*Nucifraga columbiana*), the Sierra grouse (*Dendragapus obscurus sierræ*), the pileated woodpecker (*Phlœotomus pileatus abieticola*), the mountain bluebird (*Sialia currucoides*), and the water ouzel (*Cinclus mexicanus unicolor*). John Muir has made the water ouzel immortal by his chapter in *The Mountains of California*. Climbers of the high peaks will find another remarkable bird, the gray-crowned rosy finch (*Leucosticte tephrocotis tephrocotis*), fluttering about at the very highest altitudes, even up to 14,000 feet.

The Kern River region is remarkable for the variety of its trout. Here is the only native source of the golden trout, of which there are three species all originating in a small area: the Soda Creek or White's golden trout (*Salmo whitei*), the South Fork of Kern golden trout (*Salmo agua-bonita*), and the golden trout of Volcano Creek, or Roosevelt trout (*Salmo roosevelti*). The Roosevelt trout is described by Evermann as follows: "This is the most beautiful of all the trouts: the brilliancy and richness of its coloration is not equaled in any other known species; the delicate golden olive of the head, back, and upper part of the side, the clear golden yellow along and below the lateral line, and the marvelously rich cadmium of the under parts fully entitle this species to be known above all others as *the* golden trout."[1]

There is one other species of trout native to the park, the Kern River or Gilbert trout (*Salmo gilberti*). This is a handsome fish of the rainbow series, found in the main Kern River. Most of the streams and lakes of the proposed park have been stocked with these and other species of trout, including the rainbow trout (*Salmo irideus*) and the eastern brook trout (*Salvelinus fontinalis*).

These are but some of the features of the proposed Roosevelt-Sequoia National Park. Splendid trees and brilliant flowers adorn the scene, butterflies flicker in the meadows, lizards bask on wayside bowlders, roaring streams plunge down choked watercourses or fall in graceful cascades over dark ledges, snowfields gleam in vast amphitheaters; and as the long summer afternoon comes to a close, the rays of the declining sun transfigure the mountains with purple and gold. Night falls, and the camp fire throws its flickering light over trees and rocks; moonbeams touch with silver the pinnacles of neighboring cliffs.

[1]Barton Warren Evermann: "The Golden Trout of the Southern High Sierras," *Bulletin of the Bureau of Fisheries* 1906.

Photograph by Frederick H. Morley

A glimpse of the yellow pine forest of the Sierra

THE FORESTS OF THE ROOSEVELT-SEQUOIA NATIONAL PARK

BY

ANSEL F. HALL*

JOHN MUIR considered the coniferous forests of the Sierra Nevada to be the grandest and most beautiful in the world. He was well qualified to speak, for his travels took him to all of the great forest regions of North and South America, Asia, Africa, and Australia.

The main forest belt of the Sierra lies for the most part below the region of the proposed Roosevelt-Sequoia National Park, but small areas containing specimens of almost all the Sierra trees are to be found within the contemplated boundaries. The Giant Forest region of the present Sequoia National Park contains some of the most magnificent specimens of the larger pines and firs to be found anywhere in the range. The Sierra forest is entirely different both in general appearance and tree species from the northern woods and the eastern woodlands. Of the thirty-five or forty species which make up the forests of the Park, not more than a dozen are exceedingly abundant. There is little undergrowth in the higher elevations and, topography permitting, one may ride or walk at will through the forest without the need of trails or of an ax to clear the way.

The appearance of the Sierra Forest varies with great regularity in accordance with the altitude of the country; in fact, the mountaineer comes to speak of being in the main timber belt, the red fir belt, or the timber-line belt, and gauges his elevation with considerable accuracy by the species and character of the trees. Of course these belts merge into one another, and on steep slopes they may be displaced downward or upward by a north or south exposure, but at each

*Park Naturalist, Yosemite National Park successive altitude a certain forest type predominates.

Approaching the Sierra from the west one crosses the vast, semi-arid plain of the San Joaquin Valley, which supports a few drought-resisting oaks. In the foothills the valley live oak is joined by the blue oak and the buckeye and (except in a broad belt near the Kaweah River) by the silvery gray, many-branched digger pine. Along the streams at these elevations one will find the alder, cottonwood, western sycamore, and California laurel.

At altitudes of from 3000 to 5000 feet, varying with the slope and exposure, the foothill forest suddenly gives place to the main timber belt of the Sierra Nevada. The first trees encountered are the western yellow pine and the incense cedar, and a little higher these are joined by the sugar pine and the white fir; in favored localities are also the flowering dogwood and the giant Sequoia. Farther north, where the western slope of the range is more gentle, this magnificent forest belt is many miles wide, but here in the south the abrupt slope makes the strip considerably narrower. It widens, however, to take in the whole plateau upon which we find Giant Forest and also follows eastward up the main cañons, but for the most part it lies west of the boundaries of the proposed park.

Gradually the pines become fewer until at about 7500 feet they disappear and the white fir is joined by its relative the red fir. Pure forests of this latter species on the slopes and dense stands of lodgepole pine, or "tamarack," on the flats characterize the typical mountain forest belt. Bordering the high meadows we often find the beautiful little quaking aspen, and the western white pine (or mountain pine) becomes common among the red fir of the higher elevations. Junipers often dot the exposed rocky slopes and struggle upwards almost to timber line.

In this region timber line lies at an altitude of 11,000 to 12,000 feet, and the upper thousand feet of parklike woodland is known as the alpine forest belt. At its lower limit are gnarled dwarfs of "tamarack," western white pine, and red fir, and now and then a mountain hemlock. But the hardiest warriors in the battle with the elements are the foxtail pine in the south and the white bark pine in the north. What explorer of the higher regions has not admired their pluck and sturdiness as they appear to toil upwards, prostrate against the ground perhaps, but still fighting!

The oaks of the lower elevations and the moisture-loving, broad-leafed trees which border the streams in the deep cañons form a very small proportion of the Sierra forests. By far the most important in every way are the conifers, and whoever spends any time in this region comes to know these evergreens and to greet them with friendly recognition. Much has been written about them and much remains to be told; here only brief mention can be made of the more abundant and remarkable species.

The Big Tree (*Sequoia gigantea* or *Sequoia washingtoniana*) is the oldest and largest of all existing trees. The mightiest specimen, "General Sherman," stands in Giant Forest in Sequoia National Park. Its diameter is $36\frac{1}{2}$ feet at the ground and $27\frac{1}{2}$ feet twelve feet above the ground; the height is $279\frac{9}{10}$ feet. The age of the giant Sequoia has been frequently overestimated, but the longevity of some specimens has been accurately determined to exceed three thousand years and in all probability the oldest approach four thousand. This is sufficient to give the species the distinction of being the oldest living thing. The Big Tree is found in groves along the western slope of the Sierra Nevada at altitudes varying from 4800 to 8000 feet, the elevation increasing toward the south. Professor Willis Linn Jepson, the leading authority on the trees of California, lists thirty-one distinct groves and another was discovered in the summer of 1921. Of these the largest is

Photographed by Ansel F. Hall

A timber forest on Mount Guyot. In the distance is the crest of the Sierra, the eastern boundary of the proposed park. The streams of this region are the home of the golden trout

Photographed by Ansel F. Hall

A typical forest of the high Kern Plateau. Mount Whitney, 14,501 feet in height, dominates the landscape

Giant Forest in Sequoia National Park. The proposed boundaries of the Roosevelt-Sequoia National Park include, besides the Giant Forest, several other groves of big trees, some of which are a part of the Boulder Creek Grove, between Boulder Creek and the Kings River Cañon; the North Kaweah, or Muir Grove, near Dorst Creek in the present Park; and the Redwood Meadow Grove, just east of the present boundary of Sequoia National Park on the Middle Fork of the Kaweah River near the junction with Cliff Creek. This last grove, containing two hundred eighty Sequoias, is on patented land but has not so far been cut for lumber. Steps are being taken by public-spirited citizens to purchase this land and timber for restoration to the national domain, as it is far more valuable for recreational purposes than for the lumber necessities of the vicinity.

The proposed enlargement will exclude two other important groves in Sequoia National Park. These are the Atwell's Mill Grove, on the East Fork of the Kaweah River, and the Garfield Grove in the cañon of the South Fork. There are also two groups of minor importance. The Atwell's Mill Grove was recently purchased from its owners by private subscription and presented to the national domain through the Department of the Interior. Since it is the policy of the Forest Service, into the custodianship of which these groves will pass, not to permit the cutting of any big trees under its jurisdiction, the Atwell's Mill Grove and the Garfield Grove will be saved from destruction even though not included in the Park.

Next to Giant Forest the largest groves are the Redwood Cañon Forest, situated just north of the present boundaries of Sequoia National Park, and the Converse Basin Forest, between General Grant National Park and the Kings River. These are both privately owned and may be cut for lumber. The Redwood Cañon Forest is still practically untouched, but the Converse Basin district presents a most desolate appearance. Just east of Converse Basin logging is now going on in the Boulder Creek Grove, much of which is privately owned. There are still some fine stands of big trees near Boulder Creek which might be saved, but they are outside of the proposed boundaries of the Park and the amount of money required to purchase them is too large to be expected from private sources. It is safe to predict for this region that before many years all, save the few trees which are on government land in the national forest, will have been destroyed. South of the present boundaries of Sequoia National Park are a number of very fine groves, some of which are in the national forest and others privately owned. One of the best is known as the Tule River Forest. These southern groves have not yet been seriously encroached upon, but their future is still to be determined.

Second in interest to the Big Tree is the sugar pine (*Pinus lambertiana*). This, the world's largest pine, attains a maximum height of about 200 feet, but ordinarily does not exceed 150 or 175 feet, with a diameter of from 4 to 12 feet. The features that most attract attention are the beautiful red bark, the long, graceful branches extending at right angles to the trunk near the top, and the remarkable, large, feathery cones, which hang from the ends of the branches and are found strewn over the ground beneath.

The sugar pine occurs within the limits of the Roosevelt-Sequoia National Park in considerable numbers in the Giant Forest region and also in a belt along the sides of the Kings River Cañon and other gorges. There are some magnificent specimens in the neighborhood of Tehipite Valley, and one of the finest cañon views in the mountains, that from the Tehipite Trail looking up the Middle Fork Cañon, is enhanced by a foreground of the picturesque branches of sugar pines with their cone tassels. But the sugar pine is not a high mountain tree, and throughout the greater part of the Roosevelt-Sequoia area it is not to be found.

Closely related to the sugar pine is the western white pine (*Pinus monticola*), also known as the mountain pine or silver pine. This is a very common tree in the Northwest, where it is cut extensively for lumber, but in the Sierra it occurs only at high altitudes, forming parklike and somewhat stunted forests. In the Roosevelt-Sequoia region the species grows at elevations of from 8000 to 11,000 feet and is one of the trees most frequently encountered on the high mountain slopes.

The two other white pines of the region occur at timber line. One of these, the foxtail pine (*Pinus balfouriana*), is the dominant tree at upper elevations in the present Sequoia National Park and southward. It is particularly abundant on the high plateaus of the Kern. It can readily be distinguished by the "foxtail" character of the branch tips, the bushy foliage of which is made up of short, five-needle bundles.

In the northern part of the Roosevelt-Sequoia Park area we find the whitebark pine (*Pinus albicaulis*) replacing the foxtail pine of the south. This inhabitant of the bleak upper slopes shelters the camp of many a mountaineer and provides deep, soft beds of needles, which are the delight of the tired knap sacker. The five-needle bundles, the smooth, white bark on the flexible branchlets and on the young trees, and the small, hard, purple cones are marks for easy distinction.

The two yellow, or three-needle, pines to be found in this section of the Sierra are the western yellow pine (*Pinus ponderosa*) and the Jeffrey pine (*Pinus jeffreyi*). These noble trees raise their domelike crowns almost as high as those of the sugar pine and are indeed fit companions to that patriarch of the pine family.

Probably the most widely distributed tree in the territory of the proposed park is the lodgepole pine, or "tamarack," (*Pinus contorta*).[1] This tree forms the most extensive forests of the region and has the widest range. Climbing upward the mountaineer always welcomes it as announcing his arrival in the High Sierra. It may be found between the altitudes of 5500 and 11,500 feet, but grows most abundantly at about 9000 or 10,000 feet. Besides bordering streams, lakes, and mountain meadows, this hardy pioneer struggles upward in the most inhospitable places almost to timber line. The tree is extremely variable in appearance. The best specimens stand straight and well formed to the occasional height of one hundred feet; stunted and Japanesque dwarfs lend great charm to many miniature glacial lakes; and on exposed rocky points a rugged sturdiness is developed akin to that of the juniper. No one who has slept on the ground in any part of the Sierra can forget the little, burlike cones of the "tamarack." A large proportion of Sierra bivouacs are made beneath this tree, and the first duty in preparing a bed is to brush out all the little cones. And yet, no matter with what care the bed has been prepared, the sleeper is frequently awakened in the middle of the night by the prod of a little knob, and he will not sleep again until he has picked out this one last cone which seems always to be overlooked. The flaky, purplish bark, the small size, the short needles, and the small cones serve as marks of easy distinction. The lodgepole pine is of practically no value for lumber, as it is too small and grows in inaccessible regions.

A most interesting pine, which normally occurs on the semi-desert slopes of the Owens Valley many miles to the eastward, is the one-leaf piñon (*Pinus monophylla*), which grows abundantly in a very limited area in the vicinity of Mist Falls near Kings River Cañon and

[1]The name "tamarack" is used locally in the Sierra Nevada. The tree to which it is applied is a wholly different one from the true tamarack of the eastern United States.

is found in a few other isolated situations on the western slope. The large nutritious nuts of this small tree were prized by the western tribes of Indians as well as by those east of the range and were often obtained from the latter in exchange for acorns. Doubtless the few exotic groves found on the western slope sprang from seed dropped (or perhaps planted) by the aborigines.

There are five other cone-bearing trees in the region: the red fir, white fir, and hemlock, which belong to the pine family; and the incense cedar and juniper, which represent the cypress family. The slender, symmetrical spires of the white and the red firs add greatly to the beauty of the mid-Sierran forests. The fact that their cones stand erect on the topmost branches distinguishes them from all other Californian evergreens. Both trees are exceedingly beautiful, especially in their younger life when the light, graceful branches stand out in regular whorls from the silvery white trunk. The white fir (*Abies concolor*) prefers the lower altitudes; the red fir (*Abies magnifica*) grows abundantly above 8000 feet, mingling with the lodgepole pine and western white pine.

Among the most graceful of Sierran species is the mountain hemlock (*Tsuga mertensiana*), which is a timber-line tree from Alaska southward. Within the boundaries of the proposed park it is rather scarce, making its southernmost appearance at Bubbs Creek far above the Kings River Cañon. The drooping of the tip and the ends of the branches are characteristic of no other native conifer and make the tree easily recognizable from afar.

The incense cedar (*Libocedrus decurrens*) is one of the commonest trees of the middle altitudes. It thrives best with the western yellow pine at altitudes of from 4000 to 7000 feet, where its stringy, yellowish to cinnamon-brown bark is sometimes mistaken for Sequoia by uninformed observers. The spicy fragrance of the heartwood and the pungent odor of the foliage make the common name of this tree quite appropriate.

A picturesque inhabitant of the rocky upper slopes is the western juniper (*Juniperus occidentalis*). Its gnarled habit and bleak surroundings make it the very emblem of strength and resistance, and give it a personality possessed by few other trees. The fibrous, brown bark is exceedingly thin and continuously flakes off in strips. The minute leaves are scalelike and closely pressed to the round branchlets. The small, round, bluish fruits are really modified cones but appear to be berries.

An interesting evergreen, though not a conifer, is the California nutmeg (*Tumion californicum*). Its sharp-pointed, needle-like leaves give it somewhat the appearance of a fir, but the fleshy fruits which hang from the branches like plums prove it to belong to another family. This small tree is nowhere exceedingly abundant, but specimens may be found in the lower reaches of many of the cañons.

This list, necessarily incomplete, gives some indication of the forest riches of the existing Sequoia National Park and of the larger area to be embraced by the proposed park.

FLORAL DESIGNS IN TEXTILES

PLANT MOTIFS BASED ON STUDIES MADE BY MISS ANNA HEYWARD TAYLOR AT KARTABO, BRITISH GUIANA

FROM of old, man has shown a desire to introduce into his decorative designs suggestions of the flowers that delight him in nature or that have become intertwined with his spiritual life. The "lotus" bloomed not only in the watered areas of ancient Egypt but was immortalized in stone on the columns supporting the temple roofs. The acanthus leaf is preserved for all time in the Corinthian capital. Even in our ultra-urbanized modern centers of population, there is still something in the pattern of the carpet we tread upon, or possibly in the upholstery of this room or that, suggestive of growing things. Yet in most floral designs there is so much matter-of-fact conventionality, so little appreciation of the structural significance and beauty of plant life that one turns with a sense of refreshment to work like that produced by Miss Anna Heyward Taylor, who has translated into textile designs the flowers which she has painted during her two sojourns at the Tropical Research Station of the New York Zoölogical Society at Kartabo, British Guiana. For several weeks in March and April of this year her textiles, including shawls, curtains, panel cloths, and even a gown, were on exhibition in the hall of forestry of the American Museum, together with a series of her paintings of plants.

It was while sketching in Provincetown that Miss Taylor made the acquaintance of Miss Rachel Hartley and her brother, Mr. Innes Hartley, who was interested in the work of the Tropical Research Station. In company with Miss Hartley and several others Miss Taylor went to the Station in 1916 for a sojourn of four months. There she found her opportunity for making decorative, as well as faithfully executed, studies of the tropical flora, much of which still requires identification. America's entry into the war prevented temporarily the resumption of the work at Kartabo but in May, 1920, she again visited the region and on this occasion made a stay of six months. She had, in the interval between her two visits, learned the process of Batik and had con-

A curtain design having as its motif the tropical tree *Grias cauliflora*

ceived the idea of using the tropical flowers as motifs for designs in textiles.

Although originally a landscape painter, so successful was Miss Taylor in the new branch of art to which she had decided to devote herself, that her first three designs received honorable mention at an exhibition held at the Art Alliance. To-day her work has become so absorbing that, rather than divert a part of her energies to other tasks, she declined recently an offer of a teaching position in the New York School of Applied Design.

Miss Taylor's work as exhibited at the Museum illustrates the extent to which nature may be drawn upon in the search for novel and pleasing arrangements of form. A cross section of the fruit of a

An orchid copied from nature (upper picture) and used, practically unaltered, as a repeat design on a silk panel cloth (lower picture)

TYPES OF FLOWERS PAINTED BY MISS ANNA HEYWARD TAYLOR AT THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOÖLOGICAL SOCIETY, KARTABO, BRITISH GUIANA tropical plant, the *Marcgravia*, furnishes one of the spectacular designs. A cross section of a Dutchman's pipe is perpetuated in another. In her earlier work as a landscape painter, Miss Taylor had given her attention to the larger features of things, with comparatively little emphasis upon details. Her present work has necessitated a reversal of this technique for it has involved at times the reproduction of objects seen to advantage only under a high-power microscope. An example of this is a design based upon a cross section of a piece of wood, the cells of which form a delicate pattern.

Not only plants but insects, too, have given suggestions of form and color. The design of one of the textiles was suggested by the markings on the sedately colored underside of the wing of a *Morpho*, so strongly in contrast with the bright, metallic blue of the upper side of this butterfly's wing, yet in its way just as beautiful. In the case of another design, the nymph of a katydid was the very element needed to carry out the artist's conception.

As one approached the exhibit the first thing to attract the eye was a decorative curtain having as its motif the tree, *Grias cauliflora*. This tree has a crown of leaves from three to four feet long, radiating from the top of the stem, and on the dark, slender trunk, which in nature attains a height of about thirty feet, grow clusters of heavy, white flowers that droop gracefully. One of the most beautiful of the textiles is a shawl into which have been combined as elements of the design the wild cocoa bean and the *Moronobea* with its bright red clusters of flowers. The adaptability of certain plants to decorative use in textiles is well illustrated by the almost literal transfer to the silk background of an orchid, practically as it was recorded from nature, even to the slant of its roots. This flower is used as a repeat and the result is a design that is simple, truthful, and pleasing.

While emphasis has been laid on the textiles, to which most space was given in the exhibit, many visitors must have been equally impressed by the original paintings of plants. The fidelity of these paintings, the appreciation of form and tint which they reveal, assure them high rank among Miss Taylor's productions.

A branch of the wild cocoa bean, one of the motifs employed in the shawl

The clustered red flowers of the *Moronobea* also figure in the design

SCHOOL COURSES VITALIZED BY THE AMERICAN MUSEUM

HOW THE WORK OF VISITING CLASSES GAINS ADDED SIGNIFICANCE

BY

GRACE FISHER RAMSEY*

GEOGRAPHY and history are proving unusually interesting this term to the pupils of the 6-B Grade of a public school in Manhattan. Their teacher obtained permission from the principal to bring the children to the American Museum every Friday afternoon, and the department of education of the Museum, by preparing an outline of topics which followed closely the course of study prescribed for the grade, has unlocked for them such a wealth of material relating to their studies that the dry facts of the text books have taken on real life. For example, most children learn in their geographies that coal mining is one of the principal industries of Pennsylvania. They may read that coal is dug from the ground and that there are cars which bring it to the surface, but that is about the limit of their knowledge.

Through the aid of the Museum the girls in the grade mentioned have had facts presented to them in a more vivid way. When Pennsylvania was the subject of their geography lesson, they came to the Museum and were taken by their teacher to a small lecture room set aside for their use. Here were shown them, by means of stereopticon slides supplied by the Museum, restorations of the plants growing during the Coal Period and the different steps in the process of coal mining. The lecture over, a trained guide from the department of education of the Museum conducted both teacher and class to the exhibits bearing directly upon the topic. They were shown the fossil plants found in the coal measures and the various kinds of coal that are mined. They learned by actual comparison the differences between bituminous, cannel, and anthracite. They saw the hundreds of coal-tar products and learned how the black coal furnishes us with our most brilliant dyestuffs and many of our pharmaceutical products.

The preparation of material required for such a lesson demands a long period of time. The securing of specimens and the mounting of the exhibits, the taking of the photographs, the making of the lantern slides, the shaping of the manuscript for the teacher's lecture, and the training of the guide, represent a vast amount of work and resources completely beyond the reach of any school. Yet all these facilities were made so easily available to the class that probably not even the teacher herself realized fully what had been done for her pupils.

Thus far the class has learned not only about coal mining, but also about our forests and their uses, not by a dull text book study but by seeing with their own eyes and feeling with their own hands the wood and bark of the giant Sequoias and the other native woods in the forestry hall. They have studied the early history of New York in the Indian hall, examining the wampum belts, seeing the very clothes that the Indians wore, the food they ate, and the implements they used. They know the Indians who live in the Southwest, the terraced homes that many of them build, the blankets woven by the Navajo, and the baskets designed by the Pima. They know the Grand Cañon not only from the beautifully colored lantern slides but also from the model in the geology hall.

This is just one instance of the way in which the Museum is coöperating with the schools of New York. It is an example of the possibilities of correlating the work of the classroom with the work of the Museum. It is merely the systematic use of the facilities that are available to any group of pupils and shows the advantages of such study.

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NOTES

NEW MUSEUM BUILDINGS

The work that the American Museum is accomplishing as an educational force in the life of the nation has been recognized in a substantial manner by the Board of Estimate and Apportionment, which, in authorizing sums for the erection of new buildings that were sorely needed, has provided facilities for the housing and exhibition of the Museum's growing collections and for the intensifying of its work among the public schools. In an article of this issue, pp. 113-15, the projected School Service Building of the American Museum is described. The erection of two other buildings has also been made possible through the action of the Board of Estimate and Apportionment, which on December 28, 1921, voted the sum of $1,500,000 for the construction of a Southeast Wing (Asiatic Hall) and a Southeast Court building (Hall of Ocean Life).

The Southeast Wing will be erected to a height of five stories. The first floor will be designated the hall of fishes and will contain not only the exhibits at present on view in different parts of the Museum but many projected additions. The second floor will be occupied by the mammals of Asia, of which a large collection has been made by the several expeditions of the Museum to that continent and which are being added to substantially by the present expedition under Mr. Roy Chapman Andrews. The hall of recent reptiles will be located on the third floor, and on the floor above that will be exhibited the great extinct reptiles, exclusive of those that belong to the Cretaceous, which will continue to occupy the present hall of dinosaurs. The fifth floor will offer an opportunity for the expansion of the crowded scientific and administrative offices.

The Southeast Court building will be devoted to the depiction of marine life. Under the broad gallery that is contemplated will be arranged the habitat groups of seals, walruses, sea elephants, and other creatures that live in the salt waters. A reproduction of a beautiful coral reef will find place among these exhibits. Along the gallery will be placed the marine invertebrates with special attention to the shells and corals, and from the ceiling will be suspended the skeletons of large whales. The lunettes of the building will be occupied by frescoes presenting the history of the whaling industry and other topics connected with the ocean.

In addition to these liberal provisions the Board of Estimate and Apportionment made an appropriation of $110,975, on April 10, for the installation in the American Museum of exhibit and storage cases and a 500 *kw.* dynamo.

NATIONAL ACADEMY OF SCIENCES

The annual meeting of the National Academy of Sciences was held at the United States National Museum in Washington, April 24-26. In the afternoon session of April 24 a joint paper by President Henry Fairfield Osborn and Dr. C. A. Reeds, of the American Museum, entitled "Recent Discoveries on the Antiquity of Man," was presented by President Osborn. During the same session Dr. Frank M. Chapman, curator of ornithology, read a paper he had prepared on "The Distribution of the Motmots of the Genus *Momotus*," and in the afternoon session of the following day presented by title "A Biographical Memoir of Dr. J. A. Allen." The evening session of April 24 was given over to an address on "Problems of Modern Physics," delivered, under the joint auspices of the Carnegie Institution of Washington and the National Academy of Sciences, by Dr. H. A. Lorentz, professor of physics at the University of Leiden, the address being followed by a reception tendered to Dr. and Mrs. Lorentz.

THE MORGAN MEMORIAL HALL

The Morgan Memorial Hall of Minerals and Gems, presented to the city of New York by Mr. George Fisher Baker, in memory of his friend, the late John Pierpont Morgan, was formally opened on Monday, May 1, President Henry Fairfield Osborn delivering a short address at the reception held for the trustees and the members of the Museum in the evening. Through Mr. Baker's public-spirited act in authorizing the complete reconstruction of the hall at his expense, the mineral and gem collection, one of the largest and most valuable in the world, has a setting worthy of its quality. The new hall, the work of Trowbridge & Livingston, is of basilica type with a nave and two aisles surmounted by barrel vaults, the penetrations being supported on marble piers. This vaulted treatment of the ceiling offers good opportunity for the introduction of mural decorations illustrating the evolution of mineralogy. The walls and ceiling are of imitation caen stone, blending well with the cream colored marble of the piers. No more fitting memorial could have been erected to Mr. Morgan, whose gifts of gems and gem material, including the splendid Bement collection of minerals and meteorites, constitute so important a part of the exhibit of the American Museum.

GROUP INSURANCE AT THE MUSEUM

Through the generosity of the trustees of the American Museum and through the energy of the committee in charge of the negotiations, consisting of Professor Henry Fairfield Osborn, Mr. Felix M. Warburg, Mr. H. F. Beers, and Mr. George N. Pindar, there was consummated on April 12 an arrangement with the Metropolitan Life Insurance Company, whereby 252 employees of the American Museum, representing a large majority of those employed by that

The Morgan Memorial Hall of Minerals and Gems, American Museum

institution, will have the protection of group insurance.

Under the plan arrived at—a plan which was submitted to each employee individually with the privilege of acceptance or rejection as applied to his case—the employee contributes through monthly deductions from his salary an amount equal annually to one half of the required premium; the trustees pay the completing half.

Employees who have been in the service of the Museum for three months but less than one year have been privileged to insure for the amount of $500; those who have been in the service for one year or more, for an amount equivalent to their annual salary, but in no case for more than $5000.

The total insurance assumed by the 252 employees who signified their desire to participate is $504,540 and the average cost per thousand is $15.83. One of the attractive features of the plan is that an employee retired from service on pension can continue his insurance at the same rate as that available under the group insurance.

THIRD ASIATIC EXPEDITION

Mr. Roy Chapman Andrews, leader of the American Museum's Third Asiatic Expedition, has recently sent to President Henry Fairfield Osborn for approval a series of water-color sketches of Chinese reptiles and amphibians made from living specimens secured by the expedition. This first glimpse of the scientific illustrations that are being made in the field is most satisfactory. It is fortunate that the services of Mr. Wang, a Chinese artist, were secured for the work. The primary requisite of a scientific drawing is accuracy of details, whether these be of form or of color. An artistic representation emphasizes light and shadow, often to a sad neglect of details. The familiar quaintness of all Chinese art is due to a lack of molding, or handling of shadow, a substitution of receding planes for perspective, and above all, a masterly handling of the delineation. In short the mode of representation employed by the Chinese is admirably adapted for scientific illustration. It gives an exquisite quality to each illustration without the loss of color values due to excess shadows or substitution of effect for details. The illustrations submitted by the expedition are undeniably Chinese; they are also undoubtedly scientific illustrations of merit.

Many colors of reptiles and amphibians are modified in preserving. Thus blues and greens are darkened in formol, while reds are retained with their normal values. In alcohol, on the other hand, the reds and yellows are faded, while the brighter greens are seriously modified. Many experiments have been conducted to secure a preservative which would not modify the colors of the specimens, but no solution has been found which it is practicable to use on such a large scale as is necessary in general collecting. It is very fortunate that the Third Asiatic Expedition of the American Museum is to have a permanent record of the colors of living reptiles and amphibians. The color sketches which have just been forwarded to the Museum are twelve in number. They include figures of the soft-shelled turtle (*Amyda schlegelii*), a beautiful pink and black snake (*Elaphe*), and a number of frogs and toads.

The reptiles and amphibians of China are extremely interesting and for a large part unknown. Asia has been the center of radiation for several primitive groups of frogs and salamanders. Today some of the most primitive of existing salamanders are found in China. If the Third Asiatic Expedition continues its work as successfully as it has maintained it during the short time in which it has been in the field, the American Museum of Natural History will have the largest collection of Chinese reptiles and amphibians in the world.

Some time ago Mr. Gerrit Miller, of the United States National Museum, described a freshwater porpoise from the Tungting Lake, about 600 miles up the Yangtze River, Hunan Province, China. Although Mr. Miller had only the skull and neck vertebræ, it was obvious that the porpoise, which he named *Lipotes*, belonged to the family Iniidæ and exhibited many very primitive characters. This family was widely distributed in the Miocene and Pliocene but decreased rapidly in later geological times. The nearest relative of the Tungting Lake *Lipotes* is *Inia geoffrensis* of the Amazon and Orinoco rivers of South America. Since so little was known of the Chinese porpoise, Mr. Clifford Pope, of the Third Asiatic Expedition, who has been spending the winter in an intensive study of the Tungting Lake fauna, gave particular attention to obtaining a specimen of *Lipotes*. He was successful, and reports that he has watercolor paintings made by his Chinese artist and complete measurements of the fresh specimen. Also he preserved the skeleton and all of the viscera in formalin. The thorough study which will be made of these parts should throw some important light on the evolutionary history of the cetaceans, because Mr. Miller's study of the skull and neck vertebræ demonstrated that it was almost a "living fossil."

Mr. Pope has also obtained several specimens of a black porpoise without a dorsal fin, which he has provisionally identified as *Neomeris Phocœnoides*. Whether this identification will prove to be correct it is impossible to say until there has been an opportunity to examine the skeleton carefully.

The Third Asiatic Expedition has had two very important gifts during the last winter. The United States Rubber Export Company has presented all of the tires and inner tubes necessary for the motor transportation on the expedition to Mongolia. The Standard Oil Company of New York has also donated 1200 gallons of gasoline and all the lubricants required for the cars. Since the use of automobiles in the remote parts of Mongolia will be somewhat of an experiment, it is particularly desirable to have all of the equipment of the very best. If the motor transportation is as successful as is anticipated, it will demonstrate what cars can do under difficult conditions and will be a "trail-breaker" for commerce as well as science. The advantages accruing from the use of automobiles are obvious. In Mongolia, which is a country of great distances, approximately two years' work can in this way be done in six months, for a motor car can cover in one day a distance as great as that covered by a camel caravan in more than a week.

The American Museum and the Third Asiatic Expedition are very appreciative of the generosity of these companies which have so substantially demonstrated their interest in the scientific work that is being pursued.

AUSTRALIA

Writing from Ravenshoe, North Queensland, under date of January 31, Mr. H. C. Raven, the field representative of the American Museum in Australia, reports that he has thus far collected thirty-five species of mammals in Queensland and that he now has six hundred specimens of mammals. Australians, especially those connected with museums, continue to assist the expedition with every possible courtesy.

The substance of the address on "Australian Mammals and Why They Should Be Protected," delivered by Curator W. K. Gregory, of the American Museum, before the Australian Museum, located in Sydney, appeared as an article over Dr. Gregory's signature in the issue for December, 1921, of the *Australian Museum Magazine*. The loss that will result to science if the extermination of this fauna continues is convincingly presented by Dr. Gregory, who points out that it is the most interesting in the world, and that it illustrates in a wonderful way the great principles of adaptive radiation and parallelism in development.

BURROUGHS AND MUIR

On the old home farm, near Roxbury in the Catskills, where John Burroughs grew up, there is a large bowlder of red sandstone, on which the poet-naturalist, when a boy, was wont to rest from work and play. It is this "boyhood rock," to use Burroughs' affectionate name for it, that was chosen, in fulfilment of his request, as his resting place when the work and play of a lifetime were over. Close by its side he was buried on April 3, 1921, the anniversary of his birthday, and there on April 3 of the present year was unveiled, under the auspices of the John Burroughs Memorial Association, a bronze tablet, the work of C. S. Paola, reproducing in bas-relief the heroic bronze of Burroughs sculptured by Paola's brother, C. S. Pietro, and called "The Seer." Ursula and John, the grandchildren of Burroughs, were chosen to draw the veil concealing the tablet, a ceremony accompanied by the playing of Pinsuti's "Remembrance."

At the conclusion of the readings which are specified below, the grave was strewn with laurel and other woodland growths sent by absent friends and with flowers which those present had brought with them. The names that follow in parentheses indicate the individuals who read the selections specified:

"John Burroughs," a poem by Charles Buxton Going, (Poultney Bigelow); "A Tribute to Our Townsman," a poem by Elizabeth S. Patterson (read by the author); Selections from "There Was a Child Went Forth" by Walt Whitman, (Shelley Crump); "Immortality," a poem by Grace Davis Vanamee, (Ralph Ives); Readings from Burroughs' *Wake Robin:* "The Bluebird," "The Vesper Sparrow," "The Hermit Thrush," (G. Clyde Fisher); "A Word from Scotland," a poem by T. Ratcliff Barnett, (W. O. Roy); "The Woodcocks are Calling in the Swamps To-night," a poem by Louise Townsend Nicholl, (Olive Hinman); "The Wistful Days," a poem by Robert Underwood Johnson, (John Shea); April Selections from *Riverby, Signs and Seasons,* and *Birds and Poets,* (Adella Shea); "Come, April," a poem by John Russell McCarthy, (Dr. Clara Barrus); The Cradle Song of Brahms was then played.

Bronze tablet by C. S. Paola placed over the burial site of John Burroughs and unveiled on April 3. The inscription on the tablet is derived from John Burroughs' poem, "Waiting"

On the same day that the bronze tablet in honor of Burroughs, referred to in the previous note, was unveiled, two pin oaks were planted in front of the American Museum, the one to commemorate Burroughs, Lover of Nature, the other to honor Muir, the Friend of the Forest. After a few introductory words by President Henry Fairfield Osborn, of the American Museum, the trees were formally presented by Orlando Rouland, and the gift in turn gratefully accepted on behalf of the Museum by President Osborn. Several children from Public School 188, Manhattan, officially known as the John Burroughs' School, were then introduced by Mrs. Ruth Crosby Noble, of the department of education of the Museum: Celia Grindell, who recited Burroughs' "Waiting"; Sylvia Schwartz, who had memorized the poem on Burroughs written by Helen Gray Cone in answer to "Waiting", and Sylvia Rosenberg, whose recitation was a passage selected by Mrs. Osborn, from John Muir's *Mountains of California.* The tree planting then followed, Mrs. Osborn casting the first spadeful of earth for the tree dedicated to Burroughs and Mrs. Rouland doing the like for the tree commemorating Muir.

The exercises were concluded with the singing, by the members of the Glee Club of Public School 188, of the John Burroughs' song, set to Rubenstein's "Melody in F." Temporarily there have been placed in memorial hall of the American Museum, in positions corresponding with those of the two trees, a portrait of Burroughs and a portrait of Muir, painted by Mr. Orlando Rouland—lifelike representations of two men who did so much to kindle in others the love of nature which they both felt fervently.

BIRDS

On April 8 Dr. Robert Cushman Murphy, associate curator of ornithology, American Museum, lectured at Western Reserve University on his Peruvian explorations; the same date Mr. James P. Chapin, assistant curator, lectured at Toronto before the Royal Canadian Institute on the Congo and its birds.

At the regular weekly staff meeting of the department of ornithology, held on April 20, Mr. S. Prentiss Baldwin, the leading exponent of bird-banding in the United States, who was the guest of the afternoon, spoke at some length about the recently organized New England Bird-Banding Association and its formation, in which he had played a leading part.

FISHES

With the construction of the southeast wing of the American Museum assured, there is good prospect for the installation of certain exhibits that up to the present have been withheld from the public owing to the crowded condition of the existing exhibition halls. Among these is an "angler's collection," which will include noteworthy examples of fishes secured by rod and line.

A very important contribution to this collection has just been made by Mrs. S. W. Eccles, who has presented more than a dozen handsome specimens of Florida fishes obtained by her husband. These comprise, among others: a sail fish, 7 feet 10 inches long, a cobia weighing 62 pounds, an amber jack of 66 pounds, a kingfish (*Scomberomorus cavalla*) and a barracuda, each weighing 38 pounds, and a yellow jack (*Caranx bartholomæi*) of 17 pounds.

Arrangements have been made whereby Mr. Henry W. Fowler, of the Philadelphia Academy of Natural Sciences, will assist in the identification of the fishes collected by the Third Asiatic Expedition of the American Museum. Mr. Fowler has made a study of the fresh-water fishes of the Far East and is an authority on those of the carp family, so largely represented in the lakes and rivers of China. He has examined the first lot of fishes collected by Mr. Clifford H. Pope, among which he found a new loach (a carplike fish).

FOSSIL VERTEBRATES

The work which is being done for the U. S. Geological Survey in the department of vertebrate palæontology, American Museum, by Professor Henry Fairfield Osborn, Dr. W. D. Matthew, Dr. William K. Gregory, and Dr. C. C. Mook, has not been previously noted in Natural History, but in future numbers we hope to give some account of the nature and extent of two monographs—the *Titanotheres*, completed in 1920, and the *Sauropoda*, now nearing completion. The latter relates to the most gigantic reptiles that the earth has produced, which reached their climax in Jurassic time in such well-known forms as *Brontosaurus* and *Diplodocus*. In his Forty-first and Forty-second Annual Reports, Director George Otis Smith of the U. S. Geological Survey alludes to these monographs respectively as follows:

"The most notable paleontologic work completed during the year is a monograph on the Titanotheres, by Henry Fairfield Osborn, distinguished among world paleontologists and president of the American Museum of Natural History. This work is a product of a study begun nearly 20 years ago by the Survey and now completed under its auspices, with the coöperation of the American Museum of Natural History and the United States National Museum and through the courtesy of many other scientific institutions. This monumental work forms a milestone in the progress of paleontologic research in North America." (*Forty-first Ann. Rep.*, 1920, p. 52.)

"Among the more important reports in progress during the year that on the Sauropoda deserves particular mention. This monographic work, embodying the results of many years of research by Dr. Henry Fairfield Osborn, like that on the Titanotheres, is based in part on the early paleontologic explorations of the Western States, many of which antedate the present Geological Survey. These comprehensive and monumental monographs, requiring the learning of many paleontologists, have been prepared at relatively little cost to the Survey in recent years. Their continued progress is due mainly to the steadfast devotion to science of America's most distinguished paleontologist." (*Forty-second Ann. Rep.*, 1921, p. 26.)

Mr. Walter Granger, palæontologist of the Third Asiatic Expedition of the American Museum, has been engaged for some months past in explorations on the upper Yangtze-kiang, above the great gorge that forms so picturesque and dangerous a feature of its navigation between Wauhsien and Ichang. The following extracts from a letter recently received will be of interest to the readers of Natural History. It should be explained that one of the principal difficulties attending fossil collecting in China is that the fossil bones and teeth form a regular article of Chinese medicine and are to be found in all the druggists' shops. They are considered a sovereign specific for various disorders of digestion, heart affections, etc. In consequence the richest fossil deposits have been regularly mined by the Chinese for centuries, who are by no means willing to permit the "foreign devil" to come in and take what he likes, and perhaps exhaust their entire mine, without exacting from him adequate compensation. They would much rather work the deposits themselves and make sure that they get full value for the "dragons' teeth" and "dragons' bones" that with the prospector's usual optimism they feel sure must be there in inexhaustible quantities. In consequence, Mr. Granger has thus far had to rely chiefly on purchasing specimens dug out by the natives, with results which he finds exasperating. He writes:

"My work here is about ended for the season. I go on to Wauhsien on the twenty-third and shall start down river there four days later. The journey from Wauhsien to Ichang is all that bothers me now. This gorge trip, between the acts of God and of man, is always a hazard. I shall have a medium-sized junk and put all of my collections, equipment, and party aboard. There will be a crew of seven or eight to keep steering headway in the current and with good luck we should make Ichang in four days. From there on it's all simple—steamboats and trains. . . .

"Native activities in the fossil pits are rapidly slackening up and hardly any new pits have been opened since the Chinese New Year (February 1). A few that were not completely worked out before that date are now being finished and I am, of course, keeping watch of these. The attention of the laborers is being turned to their fields, which are always of first importance to them as the source of their food. Crops have been growing all winter but have required very little attention. Now warmer weather is approaching, and cultivation and new planting will be required. . . .

"In another winter we can approach the work with better understanding than now, and can probably make some headway toward doing at least part of the excavating ourselves. To see some of these choice specimens broken up as they are irritates me beyond expression—i. e. polite expression. The most annoying thing is to realize that a fine tapir skull, broken into a hundred fragments, is just as valuable to the drug merchant as if I had taken it out intact myself. I have been in some pits recently and, while conditions for working are bad, yet the excavating can be done properly. The extreme toughness of the bones is a great thing in our favor.

"One observation I have made recently is that those pits which are low down on the eastern side of the ridge, especially those close to the bottom of the valley, are rich in *Stegodon* and *Rhinoceros*, while in the pits near the crest of the ridge the former is absent and the latter rare, their place being taken by numerous artiodactyls, especially a big cervid. *Stegodon* seems to have roamed this high valley in numbers but did not venture much into higher hills. The topography of this ridge has not, I think, changed greatly since these animals lived here.

"By far the commonest beast in the pits is a rodent, of which there seem to be two species, judging from size. . . . The skull of a monkey about the size of a gibbon is one of our latest acquisitions. . . . Skulls of *Sus*, two baby *Stegodon*, a big cat, and a fairly good tapir are among the things added since my last letter.

"Recently I took a five-day trip along the ridge toward the Hupei border—both interesting and profitable. I should have gone on into Hupei but my interpreter had to turn back because of illness after the first day and I was obliged to go on with just my Number One Boy, who handles English and firearms equally badly. It's perhaps just as well, for there are ugly rumors coming from that part of the province; a Catholic missionary was killed there last month and the "Joss Soldiers" are said to be on the move again. This is a particularly nasty corner of the country—the birthplace of much deviltry of one sort and another. . . ."

LOWER INVERTEBRATES

Dr. C. Montague Cooke, Jr., curator of Pulmonata at the Bernice Bishop Museum of Honolulu, visited the American Museum during the latter part of March, to resume his work on the collection of achatinellid land snails, which he has been identifying and revising for the department of lower invertebrates. During his stay he examined, identified, and rearranged the achatinellids of the Coan and Steward collections. Among the latter he discovered three specimens of the rare *Carelia hyathana* Pilsbry, of which only three other specimens are known to exist in museums. Doctor Cooke is one of the most eminent living authorities on the land mollusks of Hawaii and especially those of the family Achatinellidæ, regarding which his knowledge is unsurpassed. Through his courtesy the American Museum has been able to negotiate an important exchange with the Bishop Museum, with the result that a number of gaps have been filled and a fine series of paratypes and topotypes have been added to the collections of the American Museum. The beautiful, striped Hawaiian land mollusks known as the achatinellids form one of the most interesting examples known of variation under geographic distribution. In this respect they parallel in the Hawaiian Islands the distribution of the genus *Partula* in the Society Islands. The colonies of the achatinellids are very numerous and circumscribed, the color markings and proportions of the snails varying from colony to colony.

MAN

A Micmac Indian family group in plaster has recently been completed and placed in the birch-bark wigwam in the Eastern Woodlands hall of the American Museum. The figures comprising it, modeled by Mr. Frederick F. Horter of the department of preparation, represent in part an actual family. The man is a fair likeness of Little Bear, a Micmac now living in Philadelphia. The old woman was modeled from a photograph of Little Bear's mother, who, in the group, is supposed to be telling to her grandchildren one of the stories about Glooscap, the Abnaki creator,—stories which have delighted white children also as retold in *Indian Hero Tales* by Gilbert L. Wilson. The little girl of the group shows her interest by looking in the direction the grandmother is pointing. The father is resting after a day spent on a moose hunt.

Wigwams of this sort were built nearly everywhere that the canoe birch grows, the region embracing northern New England and eastern Canada.

Mr. Clarence L. Hay, research associate in Mexican and Central American archæology, American Museum of Natural History, has recently returned from a trip made to Mexico in company with Dr. A. V. Kidder of the department of archæology of Phillips Andover Academy. For several years Mr. Hay has been endeavoring

The Muskrat Group in the American Museum

to ascertain the extent of the so-called "archaic culture," which seems to have centered in the Valley of Mexico, and the present trip was for the purpose of continuing this study. Although less than two months elapsed between his departure and return, the trip yielded important results. In the vicinity of Mexico City were secured a number of hitherto unrecorded specimens of the archaic type, which will be of considerable value in classifying this culture. Potsherds were secured near Chalchihuites in the state of Zacatecas. Although none of these potsherds were closely related to archæological finds of the Valley of Mexico, being on the contrary of distinct type, a vessel with affiliations to the pottery of the Valley was dug up in the Casas Grandes region of Chihuahua. Mr. Hay is confident that in time the limits of the primitive culture of the Valley of Mexico will be determined but, as the objects on which such a determination must be based lie far beneath the surface of the ground, a satisfactory conclusion can be reached only after much intensive stratigraphic work.

MAMMALS

A habitat group recently installed on the second floor of the American Museum is that of the muskrats (*Ondatra zibethica*). The scene is a marsh near the mouth of the Eel River, Plymouth, Massachusetts, as viewed from the summer residence of Director F. A. Lucas, at whose suggestion and under whose guidance the group was prepared. The immediate foreground has been changed to adapt it for the purposes of the group, and the middle distance has been shortened; but in essentials the scene is unaltered. On the left of the group is shown in cross section the "house" of a muskrat, with passageway leading from below and the air chamber occupied by one of the brown-furred animals. The background was painted by Mr. Albert Operti; the accessories, assembling, and general preparation of the group were under the supervision of Mr. W. B. Peters; the animals were mounted by Mr. Paul Engel.

The interior of a puma den is represented in another exhibit recently installed on the second floor of the American Museum. The scene is a rocky cave of our West, from which one looks out on the rugged hills, dark against the deep red afterglow of the setting sun. The puma mother and the hungry kittens have been aroused by the return of the male from the hunt. He is carrying in his jaws the limp body of a little fawn. On the floor of the cave are scattered here and there the cleaned bones of former victims. Three of the Museum's artists, working under the guidance of Director F. A. Lucas, have contributed to this effective group. The animals were mounted by Mr. Louis Jonas; the cave was made by Mr. Frederick Blaschke; and the background was painted by Mr. Albert Operti.

INSECTS

The latest report upon the extensive collections of the American Museum Congo Expedition (1909-15), is a contribution to the knowledge of African ants by Professor William M. Wheeler, research associate in social insects, American Museum, with the collaboration of Messrs. J. Bequaert, I. W. Bailey, F. Santschi, and W. M. Mann. Parts I and II, by Professor Wheeler, have recently been issued and other parts are about to appear.

In Part I (pp. 13-37) the author discusses the peculiarities of the ant fauna of the Ethiopian region and Madagascar, pointing out the affinities of this fauna with that of other parts of the earth. Of the 269 known genera of ants the Ethiopian region possesses 90, being only slightly surpassed in this respect by the Neotropical, with 97 and the Indo-Malayan, with 101 genera. Of the 90 Ethiopian genera, 34 are endemic, 48 of the remainder being also found in the Indo-Malayan region. The Ethiopian fauna, however, has only 22 genera in common with the Neotropical, a fact which is important in connection with the theories of a former land connection between Africa and South America. Moreover, most of the 22 genera are represented by cosmopolitan, or "tramp," species. The ant fauna of Madagascar is surprisingly rich, not less than 40 genera being represented in this small area. Only 4 of these, however, are endemic, while 34 are common to the Ethiopian and 32 to the Indo-Malayan, so that the affinities appear to be about equally divided between these two regions.

Part II covers 231 pages and includes the systematic study of the ants collected by Messrs. Herbert Lang and James P. Chapin, of the Museum's Congo Expedition, and also of a smaller collection made in the same region by Dr. J. Bequaert. Numerous maps show the distribution of the genera and many of the species are illustrated by excellent drawings, mostly executed by Mrs. Helen V. Ziska. Especially noteworthy are the twenty-two plates reproducing photographs of the nests of ants and the surroundings in which these insects live. Three of these illustrations are from unique photographs of East African driver ants, by Dr. J. Vosseler, offering striking examples of their migrations and of their rapacity. The others were made by Mr. Herbert Lang in the field and several of them show nesting habits not heretofore figured. The systematic treatment of the 229 species represented in the collection contains comprehensive accounts of the characters and habits of the various subfamilies and genera, which will prove valuable to future African collectors and students of ants. Sixty-nine forms—species, subspecies, and varieties—are described in this part as new to science. Very interesting is the fact that a number of these new forms have been recovered from the stomachs of frogs and toads collected by the expedition. Frequently these specimens were in a perfect state of preservation. Professor Wheeler justly calls attention to the remarkable results which may be obtained in the tropics through this novel way of collecting ants.

THE BOY SCOUT MUSEUM

The Boy Scout Museum at Kanohwahke Lakes, Interstate Park, as developed during the summer of 1921, accomplished an interesting piece of work. Financed with a thousand dollars contributed by the Interstate Park Commission, and five hundred dollars added by a friend, it was the means through which nature study became a subject of keen interest in twenty-six camps, attended by 19,000 boys and girls, the boys being in the majority. The staff of the Boy Scout Museum conducted nature hikes, gave special instruction, delivered lectures illustrated by the stereopticon, and established branch museums in several camps.

In order to carry out the work efficiently, several departments were created. The photographic department, besides taking nature pictures, handled the photographic work of all the Scouts at cost. The department of preparation made ready most of the exhibits, which included mounted birds and nests, butterflies and moths, caterpillars, wasps' nests, minerals, fungi, wood specimens, and preserved fish, besides several models showing the formation of soils, the cause of forest destruction, and a microanalysis of water. The botany department took care of the botany exhibit, which was changed three times

The Puma Group in the American Museum

The Boy Scouts Museum has many willing field workers that scour the surrounding country and bring back to the museum objects that have aroused their curiosity. Here is a group of Scouts making permanent records of selected leaves. For the purpose a leaf is covered with paint corresponding to the actual coloration. A blank piece of paper is then placed in contact with the painted surface and pressure is applied, with the result that a colored impression of the leaf is left on the paper

a week, and which included a "What is it?" exhibit, to be answered by the Scouts.

The department of zoölogy had charge of the live exhibits, such as the snakes, turtles, salamanders, crayfish, mice, guinea pigs, rabbits, and pigeons. There were fourteen species of snakes, many loaned by the New York Zoological Society. These were the most interesting of the exhibits, some of the children never having seen a snake before. The big gopher and bull snakes, the rattlesnakes and copperhead, the small hognose and ring-necked, the little milk snake, and the grass and water snakes were all there, and all appreciated. Many demonstrations a week were given by "Uncle Bennie"—as Mr. B. T. B. Hyde, the director, was known to the boys and girls—on how to handle snakes; and in numerous cases the inherent fear of snakes was dispelled. The veterinary work of the department was most interesting. At least half a dozen animals and birds were operated upon. For example, the staff set the leg of a little rabbit, mended the broken wing of a bird, removed a fishhook from the nose of a turtle, and placed the broken back of a snake in splints—and it healed!

During the last three weeks of the summer, when the radio department was in operation, news was received daily from Washington and New York, and sent out to each of the Scout camps, thus providing a daily morning newspaper.

The plans for the present summer provide for a more intensive piece of work with a greater number of instructors, nineteen including Mr. Hyde; a traveling museum and a traveling nature library will be added to the equipment. During the winter months, instructive nature talks have been given to many groups of settlement boys and girls, as well as special instruction to Scout leaders and those in training to become leaders. Three Scout museums have been started by Mr. Hyde during the past winter: one at Rutherford, New Jersey, attended by 76 boys; another at Plainfield, New Jersey, with an attendance of 35 boys; and one at the Educational Alliance, 197 Broadway, New York, with 32 boys in attendance.

THE SCHOOL NATURE LEAGUE

The School Nature League met in the auditorium of the American Museum on the evening of March 3. Mr. George S. Sherwood, on behalf of President Osborn, cordially welcomed the guests and introduced Mrs. John I. Northrop, president of the School Nature League, who took charge of the meeting.

Mrs. Northrop briefly sketched the history of the School Nature League and told in an entertaining and vital way of the good it is accomplishing in enriching and uplifting the lives of the children. Pictures were then thrown upon the screen showing children engaged in nature study, and the creatures and other things of nature which occupy their attention.

Dr. John Finley was introduced and enlivened the evening by the humorous remarks which shot through his more serious discourse. He told of his visit to the nature room in Norfolk Street and gave his hearty endorsement to the work of the Nature League. Following this, he painted in beautiful language a picture of "the wider nature room of the great out-of-doors" of the east, west, north, and south, of our great country.

Mr. Morgenthau, who has also visited the nature room, advocated in earnest words the extension of the work of the League.

A series of motion pictures was then shown, presenting the life of early spring—the peepers, tadpoles, frogs, woodchucks, apple blossoms, robins nesting, etc.—followed by a series of autumn scenes. The running fire of interpretative comments by Mr. Sherwood accompanying these pictures greatly enhanced their value.

The audience was enthusiastic and at the close of the evening chatted informally at the door, where representatives of the School Nature League were kept busy handing out literature of the League and recording the names of new members.

OTHER INSTITUTIONS

Six scientific research expeditions, which will be engaged in work for periods ranging from two to five years, are contemplated by the Field Museum. Four of the six expeditions will devote themselves to areas of South America and two will be sent to the East.

The department of geology will begin its research work in the gem-producing regions of Brazil, one of its purposes being to secure a full series of metals associating with the diamond. It will later turn its attention to the gold- and iron- mining sections of that country and to the silver- and copper-producing areas of Bolivia and Peru. The work will be done under the direction of Dr. Oliver C. Farrington, the curator of the department.

An expedition headed by Mr. E. S. Riggs, of the department of historical geology, will devote itself to the search for fossil vertebrates, visiting for this purpose the Santa Cruz beds of Patagonia and certain areas of Pampean formation in northern Argentine, as well as examining cave deposits in Brazil.

An interesting range of life zones will be covered by the zoölogical and botanical expeditions, which will work together in the interior of the Sierras of Central Peru and about the sources of the Amazon. Dr. Wilfred Osgood and Mr. J. Francis MacBride, the former curator of zoölogy, the latter assistant botanist, will have the direction of the work that is planned.

The archæological expedition, under the leadership of Dr. J. A. Mason, will devote itself to the solution of problems relating to the ancient cultures of South and Central America. An interesting phase of the undertaking will be the attempt to furnish proof of a connecting link between the Maya civilization and that of the Inca.

The work in the East promises to be no less interesting than that planned in South America. Dr. Fay-Cooper Cole will depart in June for the Malay Peninsula and subsequently will attempt to reach the interior of Borneo. Dr. B. Laufer, curator of the department of anthropology, will study the aborigines of Hainan, the large island off the southern coast of China. The enrichment of the Chinese collections of the Field Museum is one of the results to be anticipated from the proposed survey, to be undertaken by Dr. Laufer, of the Province of Fukien and Manchuria.

Dr. E. C. N. van Hoepen has been appointed director of the Orange Free State National Museum, located in Bloemfontein.

The Carnegie Institute of Pittsburgh held its twenty-sixth annual celebration of Founder's Day on April 27. President Henry Fairfield Osborn, of the American Museum, regretted his inability to be present and requested Director W. J. Holland, of the Carnegie Institute, to represent the American Museum on that occasion.

The Royal Academy of Belgium is celebrating its one hundred fiftieth anniversary May 23-24. A commemorative session will be held at the Palais des Académies on the latter date. The presence of delegates from foreign academies and associations is anticipated.

THE MADAME CURIE RADIUM FUND

The Madame Curie Radium Fund Committee, (Mrs. William Brown Meloney, Chairman), reports that the sum of $56,413.54, the balance of the contribution after the gram of radium and the mesothorium presented to Madame Curie had been paid for, was invested, as required by the statutes of the state of New York, in securities legal for trustees. As Madame Curie's status is that of a non-resident alien, and in order to stabilize the annual income regardless of changes in the income laws, the investments have been made entirely in as long-term state and municipal bonds as could be obtained, excepting a balance of a few hundred dollars, which was put into Liberty Bonds, as these could be had in denominations as low as fifty dollars. All of the investments are exempt from all income taxes in this country. The net income will be about $2500.

TRAILS IN THE ADIRONDACKS

In an article contributed to the *New York Evening Post*, Mr. W. G. Howard, assistant superintendent of state forests, New York State, points out that much has been done to make the Adirondacks a place of easy sojourn for the camper. No less than 350 miles of trail have been cleared, and selected trees over nearly a third of this mileage have been labeled with metal markers, colored to indicate the general direction in which the trails lead,—red for east and west, blue for north and south, yellow for the diagonal trails. About 180 public camp sites have been prepared. Each of these is equipped with a fireplace and a space to pitch a tent. The construction of these trails and the establishment of the camps were facilitated through an appropriation made for the purpose by the Legislature of 1920. The Legislature of 1921 failed, however, to continue the appropriation. Desirable as is economy in the conduct of public enterprises, there would seem to be many retrenchments that could with better propriety be made than one which retards the development of the recreational facilities of a region so attractive.

RECENT DISCUSSIONS CONCERNING EVOLUTION

To the discussion regarding evolution, precipitated by the attack of the Hon. William Jennings Bryan upon the doctrine in question, several members of the scientific staff of the American Museum have contributed. In *The New York Times* of March 5 President Osborn made a thoughtful reply to Mr. Bryan, insisting that "truth is truth and must prevail" and expressing the opinion that if Mr. Bryan "with an open heart and mind, would drop all his books and all the disputations among the doctors and study first-hand the simple archives of Nature, all his doubts would disappear; he would not lose his religion; he would become an evolutionist." In *The New York Evening Post* of April 1, Dr. William K. Gregory, curator of comparative anatomy, showed the vulnerability of Prof. Francis P. Le Buffe's assertions, particularly as applied to the central exhibit of the hall of the Age of Man, in the American Museum. Dr. Gregory has also given a number of addresses recently on different phases of evolution. Before the Wagner Free Institute of Science in Philadelphia he delivered between March 4 and March 25 four lectures on "The Evolution of the Human Face;" on March 29 before the Galton Society he presented "Notes on the Origin and Classification of *Homo sapiens*," and on April 10 before the New York Academy of Sciences a paper which he had prepared with the collaboration of Dr. Dudley J. Morton, entitled "Has the Human Foot Been Derived from a Gorilloid Type?" Dr. Robert Cushman Murphy, associate curator of the department of ornithology, spoke before the Park Church in Elmira—a Congregational church founded by a brother of Henry Ward Beecher—on "Bryan and Evolution," in which he pointed out that science has no quarrel with religion and then proceeded to present from many angles the evidence for evolution.

CONSERVATION

In the November-December issue of Natural History attention was directed to the prospective celebration in April of Conservation Week. The New York City Federation of Women's Clubs, of which Mrs. Richard M. Chapman is president and Mrs. Charles Cyrus Marshall, chairman of conservation, arranged an inspiring program to cover the seven days from April 2 to April 8 inclusive that were dedicated to the arousing of public interest in the protection of natural resources. A day was devoted to each of the following subjects: "Conservation and Patriotism," "Our Forests and Streams," "National and Local Parks," "Wild Life," "Great American Conservationists and Naturalists," "Conservation and Nature Study for Children." On April 3 a play, *The Spirit of Conservation*, was produced at the Selwyn Theater as part of the program.

Although the exercises were held for the most part at the Hotel Astor, three of the institutions of Greater New York were the scenes of gatherings. The topic of April 4, "Our Forests and Streams," was presented at the American Museum. On April 7 Dr. G. Clyde Fisher, of the department of education, American Museum, delivered before the Federation his address, "With John Burroughs in His Favorite Haunts." In furtherance of the purposes of Conservation Week he lectured, March 31, at the Ethical Culture School, on "The Conservation of our Forests," the address being delivered then rather than later because of the imminence of the vacation period of the school.

So many of the Big Trees are located in national parks or on privately owned lands that one is apt to overlook the fact that several thousand individual members of this royal family are under the custodianship of the United States Forest Service. As intimated by Mr. Ansell F. Hall in the article on "The Forests of the Roosevelt-Sequoia National Park," contributed to this issue, the inflexible policy of the service has been to guard these trees with zealous care. Not a single Giant Sequoia within its control has been laid prostrate by the ax. Only fallen trees that were threatened with decay if not removed have been sold for lumber. By its actions in the past the Forest Service has proved that it is faithful to its trust, and lovers of these ancient trees can feel confident that the same scrupulous and zealous guardianship will be maintained in the future.

THE FATHER AND SON LIBRARY

Although the influence of the school, the church, and the community on the development of the boy is not to be underrated, the principal responsibility for the shaping of his character, for coördinating what he absorbs through the other agencies and heading his life in the right direction, devolves upon the home. *The Father and Son Library*, recently published by the University Society, is, as its subtitle implies, a practical home plan of all-round development for the boy. Frank H. Cheley, the editor-in-chief, and Lansing F. Smith, the consulting editor, have had in the carrying out of the project the coöperation of more than a dozen associate editors, each a specialist in his field and therefore well fitted to bring out the best in the subject under his supervision. There are twenty volumes in all, the first of which is a volume of suggestion and guidance for the father, the remaining nineteen being addressed to the boy and taking cognizance of his interests and aspirations as well as awakening these. The volumes range in subject matter from "Sports and Games," "Tools and Handicrafts," and "Camping Out," to "Citizenship," "Choosing a Life Work," and "Nature's Secrets."

The editing of the two volumes devoted to the subject last mentioned was to have been entrusted to John Burroughs but his death made impossible the carrying out of this plan. Dr. G. Clyde Fisher, associate curator of the department of education, American Museum, whose years of intimate association with Burroughs would assure his sympathetic prosecution of any plan in which the Sage of Slabsides had been interested, was then chosen to edit "Nature's Secrets." Dr. Fisher defines the two volumes as nature helps rather than natural histories. They were prepared with the thought of enabling the boy to find answers readily to the many questions about nature which even a slight acquaintance with the great out-of-doors is bound to bring to the lips. In addition to contributions from other eminent students of animal and plant life, two charming essays by Burroughs are included in the first of the two volumes. Among the contributors to the second volume are Mr. John T. Nichols, associate curator of recent fishes, American Museum, and Dr. G. Kingsley Noble, associate curator in charge of herpetology in that institution, both of whom have prepared articles in their respective fields that will not only enable boys to identify the fishes and the reptiles they observe but will give them a better sense of appreciation for these interesting divisions of the animal kingdom. The second volume closes with the biographies of six great American naturalists, originally selected for the *Mentor Magazine* by Dr. Fisher and first published in that medium. Although, because of their interest for readers of Natural History, stress is here given to the volumes on "Nature's Secrets," they are but typical from the standpoint of quality of the other volumes that constitute *The Father and Son Library*.

EXCAVATIONS AT LA QUINA

The American School of Prehistoric Studies in France has been enjoying the concession to work at the La Quina archæological station, a Mousterian culture deposit of Neanderthal age rendered famous by the discovery of the La Quina skull, a cast of which is shown in the hall of the Age of Man in the American Museum. The opportunity thus offered American students not only to inform themselves of the facts of French archæology, but also to become acquainted with advanced methods of excavation which they may later apply in the American field, is due to the generous action of Dr. Henri Martin, the owner of the La Quina site.

During the season of 1921 Professor George Grant MacCurdy, of Yale University, was in charge of the excavations. He will be succeeded during the season of 1922 by Mr. Charles Peabody, Chairman of the Board of Prehistoric Studies.

The Paris office of the American School is 38, Rue de Provence, and American visitors to Paris who desire to see the La Quina station will do well to register there and communicate with Mr. Peabody regarding a visit to La Quina.

EXHIBIT OF MAMMAL PHOTOGRAPHS

There is at present on view in the hall of woods and forestry of the American Museum an exhibit of photographs of mammals that no one who is interested either in wild life or in photography can afford to miss. It was President Henry Fairfield Osborn, of the American Museum, who first advocated such an exhibit and gave the undertaking support through his advice and encouragement. A large measure of credit is due to Mr. Herbert Lang, of the department of mammalogy of the American Museum, upon whom fell the responsibility, in the absence of Mr. H. E. Anthony, the chairman of the committee in charge of the arrangements, of assuming the direction of things. With the assistance of the other members of the committee, Dr. G. Clyde Fisher and Dr. Robert Cushman Murphy, he came into correspondence with the foremost animal photographers in the country, soliciting their contributions, passed upon the pictures submitted—for the committee reserved the right to decline photographs not deemed suitable—and supervised their arrangement. In connection with the responsibility last mentioned he had the assistance also of Mr. W. E. Belanske and Mr. T. D. Carter. The result is a remarkable exhibit, consisting of no less than 1500 pictures of mammals in the wild state or in captivity, contributed by more than 100 contestants. In each of these two categories, prizes will be awarded. For the best photographs of mammals in the wild state there are three prizes of $100, $60, and $40, respectively; for the best photographs of mammals in captivity, exclusive of domestic animals, prizes of $50, $30, and $20, respectively, are offered. A certificate of honorable mention will be given to no more than five additional exhibitors in each category. The American Society of Mammalogists will be asked to select the judges. The exhibition of pictures was formally opened on May 15 and it is anticipated that it will be kept on view at least until June 15.

At a recent meeting of the Board of Trustees of the American Museum the following resolutions were adopted:

Resolved, That the Trustees accept with grateful thanks the collection of gems and precious stones which Doctor George F. Kunz has presented to the American Museum of Natural History, in the name of his wife, Sophia Handforth Kunz, and in view of this addition to the Museum's mineral collection and of the valuable service rendered to the Museum by Doctor Kunz, take pleasure in hereby electing Sophia Handforth Kunz a *Patron*.

Resolved, That the Trustees desire to express to Mr. Charles R. Knight their appreciation of his rare artistic ability and unusual skill in creating the mural paintings in the Age of Man Hall, which are distinct contributions to science and are especially valuable in visualizing the ancient life of the earth, and in recognition of his services take pleasure in hereby electing him a *Life Member* of The American Museum of Natural History.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Life Members: Mesdames J. S. Morgan, Jr., Stella Edrington Penn, Victor M. Reichenberger; the Misses A. J. Borden, Margaret H. Elliot, Anne W. Stuyvesant; Messrs. Frank L. Babbott, Jr., J. Sanford Barnes, Joseph Dowd, Henry E. Gregory, Charles R. Knight, and Wadsworth Russell Lewis.

Sustaining Member: Mrs. Van S. Merle-Smith.

Annual Members: Mesdames Francis McNeil Bacon, Joseph Blake, Emily Palmer Cape, Madeline T. Dick, Walter Douglas, W. C. Eustis, George A. Eyer, Emil Goldmark, Wilton Merle-Smith, Henry Wise Miller, Frederick W. Moss, Matthew O'Neil, Charles E. Sheppard, George E. Vincent; the Misses Katharine Allen, Frances N. Nightingdale, Elizabeth M. Van Winkle, Louise Whitin; Doctors Perceval M. Barker, Hamilton B. Frobisher, Percy Hughes, Kenneth R. McAplin, Harold Neuhof, Douglas W. Sibbald; Professors Chas. B. Davenport, Edward B. Chamberlain; Messrs. Frederick L. Allen, Charles Biberman, Samuel Shipley Blood, Kenneth Boardman, Paul Hyde Bonner, Edw. P. Borden, Charles A. Boston, Jackson H. Boyd, James A. Carr, H. L. Crawford, George Harold Edgell, C. V. Ferguson, Oliver D. Filley, C. B. Hillhouse, F. Hoyer, Arthur F. Krakeur, Thomas W. Martin, Philip J. McCook, Van S. Merle-Smith, Joseph L. Morris, Sidney Newborg, Jos. S. Rich, Joseph Seeman, Samuel Wasserman, Jere R. Wickwire, and W. Irving Wolf.

Associate Members: the Misses Annie C. Child and Iola A. Smith; Doctors Carl Althans, Charles E. Ames, E. C. Case, George E. Dickinson, J. H. Ehlers, Leland O. Howard, Percy R. Howe, N. C. Iknayan, C. E. Norton, R. O. Raymond, T. Wingate Todd; the Reverend Stephen Dows Thaw; Professor Frederick S. Page; Major Charles G. Sturtevant; Messrs. George Guy Bailey, Jr., Leonardo P. Campagna, Robert Brent Chilton, Paul Clark, R. A. Corbett, E. M. Graves, Charles E. Hadley, A. Irving Hallowell, Frederick W. Hinckle, A. B. Howell, Robert B. Hutcheson, H. H. Irvine, Wellington B. Johnson, Hervey S. Knight, Claude Macdonald, Harold L. Madison, Charles E. Marsh, John H. Miller, Allen Morgan, R. M. Patterson, Harry G. Pollard, Henry A. Redfield, Charles Ruzicka, George Bryan Shanklin, W. W. Sharrard, W. J. Simpson, Edwin C. Starks, J. M. Sterling, E. C. Swabey, Earl H. Tschudy, Oscar C. Whitney, J. B. Wilberding and Bradford Willard.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

MAY–JUNE, 1922

[Published July, 1922]

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VOLUME XXII

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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1867 – 1922

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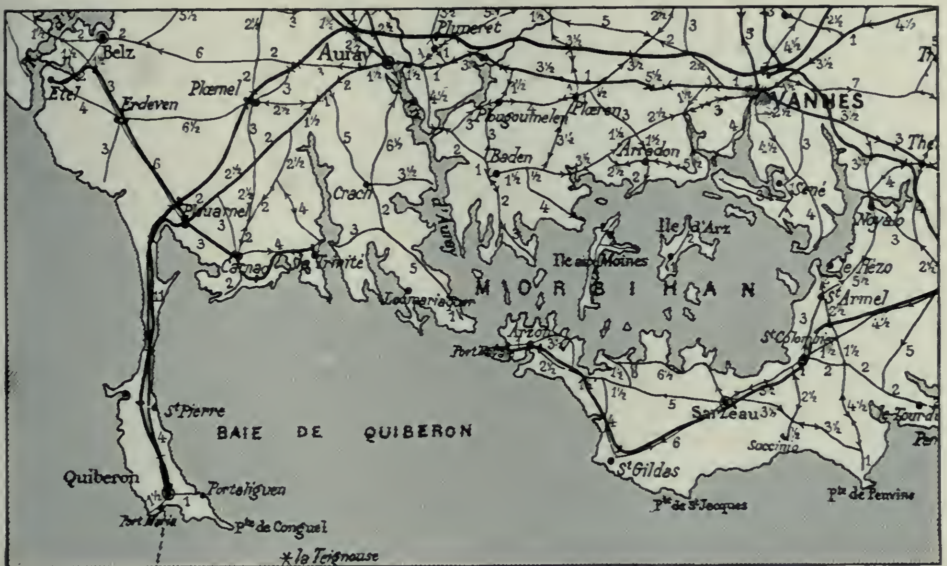


Map showing the motor routes and distances from Vannes through Auray to Carnac. From Carnac you motor to Locmariaquer. It is in the partly sunken islands of the Golfe du Morbihan that some of the most remarkable monuments are found. The region from Carnac to Locmariaquer, with its monuments, alignments, and menhirs, is shown in more detail in Edouard Basset's map on p. 206.

BRITTANY FOUR THOUSAND YEARS AGO

BY

HENRY FAIRFIELD OSBORN

ON THE evening of September 9, 1921, we left Paris, still the most modern city in the world, and on the following morning before daybreak we were in Vannes, a city known before Cæsar's time as Gwened, the capital of the Venetes, later the center of that ancient Roman province of Lugdunensis Tertia which was known in Cæsar's time as Armorica, and now in the heart of Brittany. As regards architecture, we were back in mediæval Europe, but a short automobile ride down to Carnac on the coast brought us into an age far more remote, among the ruins of monuments which were in their prime four thousand years ago. The language of the people is more ancient still; it is a little island of the Celtic speech. Yet their psychology is older than either their language or the ruins; it is the racial psychology of this people before they were Christianized.

In Carnac we realize that we are no more on the mainland; we are insulated, we are among a people very conservative of old customs, loyal but very independent, devoted to their locality, very superstitious, tenacious of old customs in dress and language as well as of old ideas. "*Ils sont mystiques; ils sont rêveurs,*" was the comment of M. Zacharie le Rouzic, the *conservateur* of the delightful little Musée J. Miln at Carnac. Although they were Christianized fifteen centuries ago, they still retain some of the ornaments of the New Stone Age as amulets to ward off the evil eye. In the chimneys of some of the houses you may still observe fine old stone celts—known now as 'thunder stones'—hung up to repel the lightning. Notwithstanding the fact that they are very devout Catholics—for we saw them entering and leaving the little church in the village square of Carnac from daybreak onward, thus evidencing their belief that a visit to the house of worship is the proper introduction to the harvest *fête*—they still rely not only upon the Virgin Mary but also upon certain ceremonials that are survivals from a religion far more ancient than Christianity itself. Some of these are supposed to insure a happy marriage, others to render certain that a marriage will be blessed with children, still others to safeguard men and animals from certain complaints and plagues or to produce fertility in cattle. An account of some of these survivals is to be found in M. le Rouzic's very delightful little volume entitled *Carnac—Légendes, Traditions, Coutumes et Contes du Pays.*

Grilled entrance gate and court of the Château Gaillard at Vannes, formerly the Hôtel du Parlement de Bretagne, and now the meeting place and museum of the venerable Société Polymathique du Morbihan. Passing within this charming entrance, the writer was received by Dr. Louis Marsille, the former president, and by MM. Allemand and H. M. Martin, officers of the Société

On the physical environment and people, Ripley may be quoted:[1]

"Brittany or Armorica, the third area of isolation, is perhaps somewhat less unattractive economically than Auvergne. It is certainly less rugged. Extending in as far as the cities of Angers and Alençon, it is saved from the extreme infertility of its primitive rock formation by the moisture of its climate. Neither volcanic, as are many parts of Auvergne, nor elevated—seldom rising above fourteen hundred feet—it corresponds to our own New England. For the farmer, it is more suited to the cultivation of Puritan religious propensities than to products of a more material kind. It is the least capable of defence of the three areas of isolation; but it redeems its reputation by its peninsular position. It is off the main line. It is its remoteness from the pathways of invasion by land which has been its ethnic salvation."

"The Alpine broad-headed type . . . is always and everywhere aggregated in the areas of isolation. Its relative purity, moreover, varies in proportion to the degree of such isolation enjoyed, or endured if you please. In Savoy and Auvergne it is quite unmixed; in Brittany only a few vestiges of it remain, as we shall soon see."

"The whole basin of the Seine was overflowed, and the incoming human tide swept clear out to the point of Brittany, where it has so completely held its own even to this day in relative purity. Topinard perhaps slightly overstates the case when he ascribes the cast of eyes among certain Breton types to an Asiatic descent."

"The anthropological fate of Brittany, this last of our three main areas of isolation, depends largely upon its peninsular form. Its frontage of seacoast and its many harbors have rendered it peculiarly liable to invasion from the sea; while at the same time it has been protected on the east by its remoteness from the economic and political centers and highways of France. This coincidence and not a greater purity of blood has preserved its Celtic speech. . . . The contrast has arisen between the seacoast and the interior. This differentiation is heightened by the relative infertility of the interior uplands, compared with the *'ceinture dorée'* along parts of the coast. The people of the inland villages contain a goodly proportion of the Alpine stock; although, as our maps show, it is more atten-

[1]Ripley, W. Z. *The Races of Europe, A Sociological Study* (Lowell Institute Lectures). Accompanied by a Supplementary Bibliography of the Anthropology and Ethnology of Europe, etc. New York, 1899.

uated than in either Savoy or Auvergne. To the eye this Alpine lineage in the pure Breton appears in a roundness of the face, a concave nose in profile, and broad nostrils. Along the coast intermixture has narrowed the heads, lightened the complexion, and, perhaps more than all, increased the stature."

These broad-headed, gray-eyed Alpines or Celts—short of stature, very Irish in appearance, but without the excitable Irish temperament—are the most ancient element in the population, but there is also a considerable Mediterranean element—narrow-faced, dark-haired, dark-eyed, with aquiline features—people who came perhaps by sea. Here and there is also the Normandy type—blue-eyed, fair-haired, with brown or sandy beard—constituting less than one tenth of the population. Conducive to racial isolation and psychical insulation are the facts that this part of the coast has no deep harbors and does not admit of modern commerce. Some far-distant day, perhaps, we shall have deeper harbors here, for the seacoast is now sinking and some of the most interesting of the old monuments are to be seen only at low tide or even beneath the surface of the sea. Another outstanding feature of the environment is the infertility and scantiness of the soil. Stones are found everywhere—all of enduring granite. After the long, overcast winters, spring is trebly welcome. As the sun begins to rise earlier and earlier, the days become warmer and longer, and seedlings sprout from the soil; finally the summer solstice is reached and the peasants rejoice, as their ancestors did four thousand years ago, in the earliest sunrise and the latest sunset of the year.

Only by seeing this environment, studying this people, and realizing that these customs have probably been handed down from the time they were first introduced, about 4000 B. C., can we grasp the significance of the monuments which have made Carnac the most famous center in all France of the period of sun worship extending from the climax of Neolithic culture to the beginning of the Bronze Age. The finest of these monuments surround the Golfe du Morbihan. They attest the greatest faith in sun worship as well as the most stupendous labor in piling up the monuments to the dead. They bear weighty testimony to the spiritual life of these people, showing that their faith in the future life of their honored chieftains prompted them to carry to completion these really titanic mechanical undertakings involving the transportation and erection of great monolithic menhirs. To some extent these menhirs suggest the obelisks of Egypt, while the tumuli suggest the pyramids, and the dolmens—consisting of two erect stones and one horizontal stone at the top—suggest the fundamental architectural units of the Egyptian temples.

Through the gateway one enters the picturesque courtyard where the Château Gaillard, closely hemmed in between two other buildings, displays its southern façade of the fourteenth and sixteenth centuries. Within are installed some of the finest collections of polished stone artefacts taken from the tombs around Carnac

We asked M. Louis Marsille, the genial *conservateur* of the Museum of Vannes, and M. le Rouzic to give us their views of the chronology of the period and the succession of cultures. Notes made of their statements form the basis of the following table, in which we observe the gradual development of the dolmens into the period of their grandeur and of their subsequent decadence, followed by the post-dolmen period which passes into the second stage of the Age of Bronze and that in turn into the Age of Iron.

It would appear that during the Age of Polished Stone and the Age of Bronze the civilization of this region was not more isolated than it is at present. Sun worship came from the east with the introduction of agriculture —perhaps from as far east as the Iranian plateau. With it doubtless came the tools used in preparing the soil, the seeds needed for sowing the crops, and the implements required in harvesting the grain. For thousands of years the ancestors of these people had observed the response of the seeds to the sun, and of the moistened soil to the genial action of the sun's rays. The agricultural bent of their mind is beautifully illustrated in their decorative motifs, the key to which appears to be afforded in the graved stones that line the tumulus of Gavr'Inis (L'Île de Gavr'Inis, certainly the most interesting island in the Golfe du Morbihan), described as "*le plus beau monument mégalithique*" in the entire world. The long gallery is still deeply buried in the heart of the tumulus and perfectly preserved. It is constructed on the unit principle of architecture found in the simplest dolmens, namely, two vertical stones with a broad horizontal stone on top, archetypes, as we have said, of the column and of the architrave of the Egyptian temple. The decoration of the sides, laboriously cut with the hardened bronze tools of the

SUCCESSION OF PEOPLES AND CULTURES IN BRITTANY

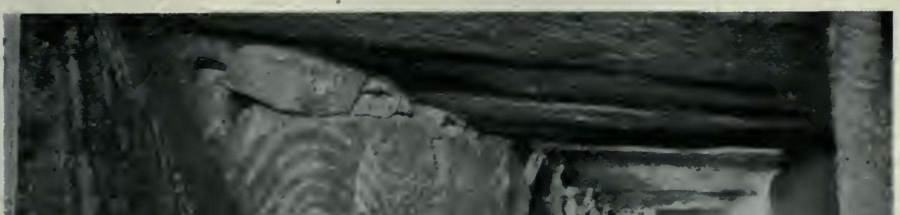
AGE OF IRON Circular burial tombs.	
AGE OF BRONZE—Stage II Incineration and interment of the dead.	Vases of graceful design. Lance points in bronze.
AGE OF BRONZE—Stage I Tombs buried beneath tumuli.	Poniard of bronze (rare) and of copper (more frequent). Superb flint arrow points.
NEOLITHIC—Stage III Decadence of dolmens—their walls of large stones or of dry masonry. No entrance passage. Burials to protect the dead. Cists quite frequent. Skeletons are placed in crouching position (*accroupi*). Beginnings of incineration.	Fine stone axes; a little pottery; bronze (rare). Arrow points of flint.
NEOLITHIC—Stage II Large dolmens with long passage entrance, built of very large stones. Cists with human remains of long-headed (dolichocephalic) type.	Ceremonial *haches*, finely polished; hammers; necklaces of jadeite. Gold (rare).
NEOLITHIC—Stage I Dolmens—small, built of small stones with no covered passage entrance. Cists. Human remains of short-headed (brachycephalic) type.	Pottery. Implements of coarse workmanship which had been used previously and then buried with the dead.

The island of Gavr'Inis in the Golfe du Morbihan near Locmariaquer, surmounted by its tumulus, within which is the most famous gallery in France with the ornamented stones shown on p. 203

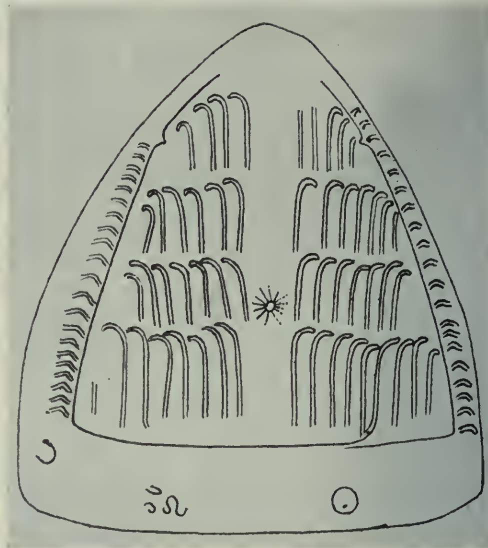
The Grand Menhir of Locmariaquer, the largest menhir known. Before it fell and broke it was more than sixty-seven feet high. In the foreground are the tablets indicating that this is a national monument. Photograph by courtesy of Monsieur V. Forbin

Upper picture—Dolmen de Crucuno near Carnac. This illustrates perfectly the square or circular arrangement of the great stones of the burial chamber with the huge slab on top, the whole originally covered by a great tumulus of earth. In the present case a farm building has been erected close to the burial chamber, and probably some of the stones belonging to the entrance passage were used for its construction

Lower picture—Looking through the gallery of the dolmen known as the Table des Marchands at the triangular stone on which is engraved the wheat design



The gallery entrance, still buried within the tumulus of Gavr' Inis, is the finest in Europe, both in respect to its perfect preservation from vandalism and to the sinuous, multilinear decorations which are graved on the inner faces of all the great stones lining the gallery. The interpretation of these designs is fully discussed in "Les Petroglyphes de Gavr'Inis," *L'Anthropologie*, June, 1921, by Dr. E. Stockis, who regards them as derived from the intricate lineation of the finger-tips and palms of the human hand. By the present author they are regarded as a complex development of the wheat field pattern seen on p. 204



(Upper Left) Triangular, upright stone—on the apex of which rests one end of the giant Table des Marchands—with relief design of four rows of grain stalks, with the sun in the center of the third row. The Table des Marchands is reproduced on the cover of this issue

(Upper Right) Key to this design as interpreted by Zacharie le Rouzic and Charles Keller. Drawn by J. Keller

(Lower Left) Two clusters of seven wheat stalks each from the fields of Brittany, showing the heads bowed with grain

period, consists of long, equidistant engraved lines either arched, undulating, or coiled in spirals. The spiral coil has suggested to a recent writer that these are titanic finger prints—a sort of Neolithic Bertillon system—perhaps the finger prints of the sun god; but such an interpretation must be considered fantastic in the extreme. The equidistant lines between these grooves correspond to the symmetrically spaced stalks of rye or of wheat. The interpretation of these designs appears to be supplied by a design carved on one of the stones supporting the great Table des Marchands. It shows four rows of single stalks of wheat—with a representation of the sun in the center—bowing their heads like the sheaves of wheat in the story of Joseph.

In the opinion of M. le Rouzic and M. Louis Siret this great bowlder of granite was cut in the late Stone Age. M. Siret is quoted by M. le Rouzic as follows:

"Le polissage n'est pas le dernier perfectionnement du travail de la pierre. Les plus anciens outils polis ne sont pas en silex, mais en roches telles que la diorite et la fibrolithe qui n'étaient pas employées avant l'application du polissage. La taille du silex s'est au contraire faite par éclatement pendant la majeure partie de l'âge de la pierre polie. Le procédé du polissage est exclusivement employé à un genre d'instruments répondant à des besoins d'un ordre nouveau, formant un attirail nouveau, indépendant de celui en silex, autant par les formes que par le procédé. En un mot, la pierre polie est un temoin de l'avènement de l'agriculture; les instruments qui l'accompagnent sont créés pour la construction de maisons, de dépôts, d'appareils divers pour l'agriculture et les industries nouvelles, et impliquent un usage très fréquent

(Left) A series of engraved, vertical stones in the side walls of the gallery within the tumulus of Gavr'Inis

(Right) Engraved stone within the tumulus of Mané-er-H'roëk with an animal symbolism above and a crude representation of a ceremonial ax below

du bois. La hache polie n'est pas un symbole de la guerre, c'est celui de la civilization nouvelle, que résume l'agriculture."[1]

This design of the grain field is apparently unique, although a design in the tumulus of Gavr'Inis may possibly be a conventionalized variant. We can imagine the labor involved in cutting these designs even with the hardest implements of polished stone, and also the strong religious and artistic impulses which inspired this labor. These people not only had a vision but they had tremendous will power, as manifested in the execution of these difficult designs, not to mention a knowledge of the mechanical appliances necessary to transport the titanic megaliths. Doubtless the work was directed by priests and the laborers were commanded by chieftains, but great numbers of people must have responded with a will that felt the urge of an indomitable purpose. Only by viewing these giant stones and this infertile country can we appreciate how the energy which drew crops from the reluctant soil was turned with corresponding fervor to the purposes of religion and of art, resulting in crude but grandly conceived monuments of worship and of burial. Mute witnesses to the powerful appeal made by this religion extend across the great continent of Eurasia, for the monuments are found from Corea westward to the remote parts of Brittany.

From the central Alpine race, which was the chief disseminator of the art of agriculture and the religion of sun worship, these ideas were spread to the Mediterranean race in the south and to the Nordic peoples in the north. It is believed that the megalithic funereal monuments were introduced by the Mediterranean race and, if so, they were first erected not by the Alpines but by the long-headed Mediterraneans. This combination of sun worship in the interests of agriculture and of the cult of the megaliths

[1]Siret, L. *Orientaux et Occidentaux en Espagne.* Joseph Pollennis, Brussels, 1807, p. 8.

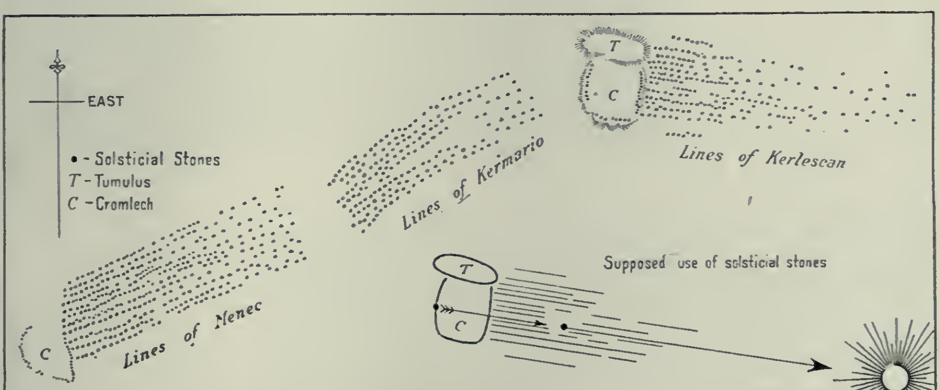
The region from Carnac to Locmariaquer—detail from the "Carte archéologique du Morbihan" by Edouard Basset, as given in the classic work *Fouilles faites à Carnac* (published in 1877) by James Miln, who founded the Musée J. Miln at Carnac, now under the custodianship of Zacharie le Rouzic

was very wide-spread, and may have been the contribution of more than one race. The megaliths in the south of France date from the beginning of the Bronze Age, namely, about 2000 B. C. as attested by the occurrence of bronze weapons and tools in the interments. In the north of Europe bronze was very rare and very costly. It came a long distance both to Brittany and to Scandinavia. The stone-cutters of the period were forced to use tools of the hardest kind of stone.

At the climax of the megalithic period, characterized by great tumuli with the dolmens within, and by long entrance galleries like those of Gavr'Inis, these people reached the height of their sun-worship civilization, which was parallel with the highest development of their inner spiritual forces, the source of which is so mysterious.

Near Carnac are two great ceremonial centers consisting of circles of stone known to the Bretons as cromlechs, from which extend outwards long lines of stones known to the Bretons as alignments. These are the famous "Alignments de Carnac." It is in the cromlech that we find a close parallel to the most famous circle of all—Stonehenge on the Salisbury Plain, England, the astronomic significance of which has been studied by Sir Norman Lockyer, who calculated that on midsummer day June 21, 1680 B. C., the sun must have risen exactly over the spot now occupied by a modern benchmark on Sidbury Hill, eight miles northeast of Stonehenge and in a direct line with the center of the circle. He calculated that this was the date of the erection of this monument, with a margin of error of two hundred years, namely, from 1480–1880 B. C. The latter date is the more probable, for from collateral evidence in Brittany the year 2000 B. C. marks the close of the Neolithic—the period of splendid polished *haches* of jadeite—a period when bronze was in full use along the Mediterranean trade routes with which Brittany was only in distant connection. As with Stonehenge each cromlech of Carnac has its solsticial line, and this is especially apparent because at some distance from the circle stands the more or less permanent solsticial stone *between* the alignments and not a part of them. The direction of the seven or eight lines of great parallel stones is *eastward* or *southeastward* from the cromlech. This is also the direction of the gallery which extends

Alignments du Menec, Carnac. The photograph was taken from the edge of the cromlech looking eastward. There are three groups of these alignments—each with its ceremonial circle—namely, the lines of Menec, Kerlescan, and Kermario. Kerlescan has thirteen lines of parallel stones extending 2887 feet in length. In Menec there are ten (eleven) lines. Many of the stones of its cromlech have been removed to build farmhouses and walls. Photograph by courtesy of Monsieur V. Forbin



Key to the Alignments of Carnac, after drawings in James Ferguson's valuable work *Rude Stone Monuments*, published in 1872. Each of the alignments has its cromlech (C), or sacred circle, from which the alignment extends to a great distance. Ten (eleven) rudely parallel rows of menhirs form the alignments of Menec; there are ten rows in the alignments of Kermario, and thirteen in those of Kerlescan. As pointed out by Monsieur le Rouzic, solsticial stones are sometimes placed between two lines and within the cromlech, as shown in the diagram based on a sketch by the author

The three racial types of modern Brittany are shown in the accompanying photographs of young married couples, in their characteristic native costumes. It is thus they are arrayed at the Breton fêtes, such as the harvest festival, which the author was fortunate enough to witness on Sunday, September 11, 1921.

ALPINE TYPES OF QUIMPER—A NEWLY WED COUPLE

A COUPLE FROM BANNALEC, OF ALPINE (LEFT) AND NORDIC OR NORMAN TYPE (RIGHT)

A COUPLE FROM SCAËR, OF ALPINE (LEFT) AND ALPINE-MEDITERRANEAN TYPE (RIGHT) from the central burial chamber within the tumulus. Thus the body of the chieftain—buried with all the ceremonial axes or celts—reposed in a chamber the connecting gallery of which faced the rising sun.

Race mixture came not from the interior but by the sea. The Saxon navigators skirted the whole coast—the largest Saxon colony was, in fact, around the Golfe du Morbihan. This is inferred from certain indications in the Breton peasantry of a blond cross in early prehistoric times; but the prevailing complexion is dark, the stature is short, and the face is either of the broad Alpine type or of the narrow Mediterranean type, or else of a blond between the Alpine and the Nordic (blond type of Normandy). Certainly the prevailing color of the hair is dark; this is either Alpine or Mediterranean—blonds are very exceptional. The prevailing form of the face is broad; this is indicative of the Alpine. There are, however, many oval faces, which represent a blend between Alpine and Mediterranean. The prevailing complexion is of the lighter Alpine type rather than of the olive Mediterranean type. Unfortunately, few archæologists have interested themselves in this matter of race mixture, but Déchelette observes: "On doit admettre chez les peuples qui ont élevé les monuments mégalithiques une certaine communauté de culture, mais nullement une communauté de race." This is certainly true if applied to the building of the megalithic monuments in general, but it is not true of the erection of the monuments of Brittany, which were the work primarily of people of Alpine origin.

RUINS OF THE GREAT TUMULI

Unless you visit this country, it is difficult to realize that each dolmen is the vestigial stone skeleton of a tumulus of earth. It would appear that originally the dolmens were built laboriously of stone, and then laboriously covered with earth; that the entrance galleries were regarded with reverence; that the traditions of the great chieftains and families in whose honor they were erected lasted for a long period; and that finally these traditions passed away. There were two causes of destruction. First, the earth of the tumulus was removed and returned to the farms by the thrifty agriculturists, for we can imagine how the country, poor in soil, became impoverished by the building of the great earth tumuli. Thus every dolmen that was once earth-covered is now entirely bare.

As an instance of this sort are the three dolmens with *allées couvertes* of Mané Kerioned, in which the covering soil has been completely removed,—dolmens representing the best period of the Neolithic before the Bronze Age. Here two of the *allées couvertes* point toward the south; the third points toward the north—perhaps the grave of a skeptic in the matter of sun worship. In Celtic the names of these three burial sites signify respectively mountain of the fairies, of the gnomes, of the black elves, who were believed by the ancient Bretons to have built the tombs.

Another group of dolmens from which all the earth has been removed, is that of Rondesec, beautifully situated on a mound overlooking the Bay of Quiberon; here each *alleé couverte* points directly southeast, doubtless the very direction devout sun worshippers would choose. The family here buried was prosperous, too, for the excavation of 1848 led to the discovery of two gold armlets—a discovery which prompted the spoliation of many dolmens in search of treasure.

Gold was found also in the very large tumulus of Mané Lud (Mount of Cinders), excavated in 1863; here a number of the chieftain's horses had been sacrificed and the heads placed in a crescentic line near the crypt. The crypt itself was filled with incinerated bones, indicating a period when cremation was customary; this incineration is referred to in the name of Mané Lud.

More fortunate were the dolmens of a later period, when the custom of covering them with small stones was instituted. Those tumuli the dolmens of which were covered with small stones have been preserved—there was naturally no advantage in returning these stones to the farm in a country which is as full of scattered stones and bowlders as any part of New England.

Incised symbol of the *hache*, doubtless taken from the battle-ax of the period but representing the power of the god of thunder. It is perhaps this religious significance which has survived in Brittany to this day, and leads this simple people to hang these 'thunder stones' in their chimneys to ward off lightning and propitiate the god of thunder

The second cause of destruction was the rifling of the tombs when it was discovered that articles of bronze and—still more precious—of gold were sometimes to be found in them. This kind of destruction, which was similar to that which ruined so many of the finest monuments of Egypt, also extended over a long period of time. Hundreds of valuable implements were scattered over the country to serve as 'thunder stones' in warding off the evils of lightning, and it was only with the foundation of the Société Polymathique du Morbihan[1] that these relics of the archæologic history of France began to be collected and preserved.

The dates of the successive exploration of these dolmens, indicated in the accompanying table, were kindly given to the author by M. le Rouzic.

It is noteworthy that in all the tumuli

[1]The Société Polymathique du Morbihan was founded in 1826. This society was studying the Neolithic of Brittany while the famous Boucher de Perthes was working in the Palæolithic Chellean of the Somme valley.

1832	Gavr'Inis—tumulus	Beautiful gallery, no implements.
1849	Rondesec—tumulus	Two armlets of gold.
1853	Tumiac—tumulus	Thirty-two superb ceremonial axes, three necklaces of callaïs.
1862	Mont-Saint-Michel, Carnac—tumulus	Thirty-nine ceremonial axes, two necklaces.
1863	Mané-er-H'roëk—tumulus	An oval ring of jadeite encircling a polished ceremonial axe of chloromelanite, also 101 celts or polished axes, all purposely broken.
1863-1864	Mané-Lud—tumulus	The burial chamber exceptional in containing seven heads of horses in a beautifully constructed tumulus. In 1911 M. le Rouzic found a necklace of callaïs and five small bands of gold.
1863	Kercado—tumulus	Two ceremonial axes, ornamented pottery, and a few beads of callaïs.
1864	Le Moustoir—tumulus	Pottery, flint flakes from the famous quarry of Grand Pressigny, and beads of callaïs.

Ceremonial and useful objects from the Musée J. Miln at Carnac, discovered within the dolmens in the vicinity of Carnac, including large, polished ceremonial axes, some of which are of chloromelanite and jadeite, rings of jadeite, necklace beads and pendants of callaïs, quartz, and agate, and arrow heads of unpolished flint. With these are intermingled some of the finest examples of Palæolithic and Neolithic industry

bronze is very rare, although Kercado belongs in the Bronze Age. Mané-er-H'roëk (Mountain of the Fairies) is one of four virgin tumuli found undisturbed, the others being Tumiac, Mont Saint-Michel, and Le Moustoir. It is a round tumulus built entirely of stone, doubtless in honor of a very great chieftain. The superb collection of ceremonial objects discovered here is the finest of the period which has been found in France. It includes nearly two hundred pieces, all of the finest Neolithic workmanship, in polished jadeite, chloromelanite, fibrolite, and callaïs.[1] The necklace beads are of callaïs, quartz, and agate, with not a single object in bronze and only a few fragments of flint. It represents the acme of the Neolithic period in industry and art. While there is no bronze in the ceremonial burial, the form of some of the celts, or axes, recalls bronze both in shape and in design. The splendid necklace and the very large pendants of callaïs were probably assembled from local quarries found in the Archæan mica schists. Most of the celts were intentionally broken but some of the best were left intact, including the one of chloromelanite encircled by a jadeite ring as described in the table above, which is said to be the finest in France.

M. Marsille was enthusiastic over the intelligence of the men of this period—they understood all the minerals, how to procure them and how to shape them, and sought out the rarest.

The second undisturbed tumulus is Mont-Saint-Michel, Carnac, a veritable mountain of rock, within which the galleries are lined with small tombs. These have been further investigated, from time to time, since the original discovery in 1862 by M. René Galles, who unearthed numerous celts and a beautiful necklace, or *collier*, of callaïs ornaments. Of the

[1]Callaïs is a precious stone of unknown source, closely approaching turquoise in its chemical composition, but containing a somewhat smaller proportion of aluminum. It is translucent, and apple or emerald green in color. More than 450 beads and several pendants of this substance have been found in the dolmens of Morbihan, while in the other departments of Brittany it is almost unknown. Similar beads have been found in Provence, in the Hautes-Pyrénées, and in Portugal.

thirty-seven *haches* the seven largest weapons were purposely broken; the others remained intact. Kercado is another of the undestroyed tumuli, with a circle of large stones outside the stone mound, which no doubt had some religious or mystic significance. The most recent of the untouched tumuli to be exposed was Le Moustoir, Carnac, which contained none of the large *haches* but has yielded giant flint flakes, evidently brought from the famous flint mine of Grand Pressigny, and also well-shaped vases with their supports.

Tumiac, the first of the undisturbed tumuli to be explored, was opened in 1856. It is of about the same age as Mont-Saint-Michel, as demonstrated by its closed dolmen chamber, but it lacks the entrance gallery and thus belongs to the decadent period of the tumuli. Although inferior in size to Mont-Saint-Michel, Tumiac is 345 feet long and was the burial place of twelve individuals —probably members of one great family. The excavations here yielded thirty-nine fine *haches*, examples of the best Neolithic workmanship.

M. le Rouzic, *conservateur* of the Musée J. Miln, was our genial host during our three days' study of Carnac and visit to the island tumuli of the Golfe du Morbihan. He pointed out to us the racial succession indicated first by the predominance of round-heads, whom we regard as members of the Alpine race that dominated Armorica at the close of Neolithic time (2000 B. C.), which corresponds to the Bronze Age elsewhere. Following the stately and costly burials of the round-heads came other interment customs with an invasion of long-heads, who laid out their dead in straightened form in the cists or stone coffins—rude prototypes of the monolithic stone sarcophagi of Greece and Rome. The straightened bodies of the cist burials are in striking contrast with the generally flexed bodies of the dolmen burials.

M. le Rouzic regards Carnac as a great cemetery of late Neolithic times, where the chiefs were brought for burial, the most frequent symbol being the *hache* of the chieftain, an example of which is shown in the illustration on p. 210. As bearing upon sun worship, M. le Rouzic points out that the symbol of the life-giving sun is rather rare, while the symbol of the wheat is relatively frequent. He inclines to interpret the sinuous lines of the stones of Gavr'Inis as conventionalized designs symbolic of the wheat field. He also inclines to see traces of remote Egyptian or Phœnician or proto-Phœnician influence, or of still more remote Mycenæan influence in the dome-like burial chamber of Isle Longue, where the only semblance of the surviving dolmen influence is the long *galérie couverte* facing toward the sun, and the large circle of upright flat stones around the base. Above the base is a dome-like construction of small stones introducing the entirely new structural principle of the arch. This work, M. le Rouzic informed us, is attributable to the first Age of Bronze.

Our Neolithic tour ended on Sunday, September 11, with a clear vista of history penetrating the more mysterious region of prehistory where one has to grope about for knowledge and where the constructive imagination and genius of French archæology command our admiration. To M. Louis Marsille of Vannes, to M. Zacharie le Rouzic of Carnac, and finally to my helpful friend, M. V. Forbin of Paris, I desire to extend my grateful acknowledgments for aid in recording herein my first impressions of Brittany as it was four thousand years ago.

Front view of the laboratories in Peking, which were fitted up for the needs of the Third Asiatic Expedition

SCIENTIFIC WORK IN UNSETTLED CHINA

SOME OF THE THINGS THE THIRD ASIATIC EXPEDITION HAS DONE AND SOME OF THE THINGS IT HOPES TO DO

BY

ROY CHAPMAN ANDREWS*

THE spring of 1900 is remembered by all the old residents of North China, not only because it preceded the Boxer Rebellion, but because of its dust storms. Not since that fatal year had there been such a storm as that which ushered us into Peking on April 14, 1921. The dust reached as far south as Shanghai and its yellow blanket hovered over the sea sixty-five miles beyond the coast. It came from a land dry and parched by fourteen well-nigh rainless months, which had taken a heavy toll of human life.

We could hardly see the great Tartar walls as the train came into the station, and for days after our arrival the air was dense. The Chinese are very superstitious and we were told that no good could come from a summer which began with such a dusty spring. It was a bad omen—it meant famine, war, disease, and death.

Curiously enough the foreign community is always more or less affected by the Chinese superstitions, and we were greeted with a flood of rumors: Peking was certain to be attacked and looted—even the day and hour had been set; it was impossible to go into the interior; smallpox was raging; it would be dangerous to do this and dangerous to do that!

Instead of being depressed my spirits rose correspondingly, for I knew Peking. Things are always just going to happen—but they seldom do. And the closer

*Leader of the Third Asiatic Expedition, which the American Museum is conducting in coöperation with the American Asiatic Society and *Asia*.

The "spirit doorway" of the expedition headquarters

one gets to trouble in the interior, the less impressive it becomes. Moreover, there was much to do before we could think of beginning active field work. First, the Third Asiatic Expedition must have a home.

Before I left New York I said to President Henry Fairfield Osborn, "There is one house in Peking better suited to our needs than any other. It was formerly occupied by the late Dr. G. E. Morrison and would be an ideal place for us." When we reached Peking, the house was for rent and we took it.

That sounds very simple, but renting a house in Peking (which is not a treaty port) is such a complicated matter that I have known more than one foreigner to give it up in despair and settle down permanently in the hotel. There is almost unending bargaining: middlemen with their "squeeze," the police with their squeeze, all the squeezes of the contractor, the squeezes of those in control of the water, the electric light, and the telephone, and of dozens of others, until one feels as though one had been squeezed to death. It was not until the middle of

A glimpse of the living house from the main courtyard. The office is located at the left

July that we could actually begin the work of fitting up the laboratories, the motion picture studios, the equipment, and the storage rooms.

There is a sentimental reason which makes this house peculiarly appropriate as the home of the Third Asiatic Expedition. Its former tenant, my old friend Dr. G. E. Morrison, was one of the best known Britishers that has ever lived in North China. His fascinating personality, his interest in science and exploration, his wide travels in the interior, and his magnificent library made his house a Mecca for travelers and scientists of every nationality. I like to think that Dr. Morrison would rather have seen the house he loved so well, dedicated to this work than to any other purpose. While the tedious negotiations were going on, I had been busy studying Chinese five hours a day, collecting my old native assistants, selecting new ones, and planning the palæontological work

Pavilion along the courtyard which contains equipment rooms and laboratories

of the expedition with the Chinese Geological Survey. I found Dr. Ting, Dr. Andersson, Dr. Grabau, and others most cordial in their reception and anxious to give us the benefit of their experience in beginning this difficult phase of the work. The Survey had a comprehensive and well-advanced scheme for its palæontological investigations, embracing certain provinces in which it had already begun preliminary explorations. If we invaded these areas with our own forces, it meant unhealthy competition, ill-feeling, and a duplication of results; our doing so would be at once discourteous and unscientific. Asia presents such a vast unexplored field that there is room, not only for two institutions to carry on work, but for dozens.

Therefore we arranged a plan whereby certain regions should be left entirely to us, and others investigated without competition by the Survey. Moreover, there can be much coöperation and mutual assistance, and the value of the work of both institutions can be correspondingly increased.

At the end of June the first two members of our staff arrived—Mr. Walter Granger, palæontologist, and Mr. Clifford Pope, assistant in zoölogy. Mr. Granger has so long been connected with the American Museum and has taken such a prominent part in its palæontological work that he needs no introduction to the readers of NATURAL HISTORY. Mr. Pope is a young alumnus of the University of Virginia, who has had preliminary training in South America at the Tropical Research Station of the New York Zoölogical Society, which is under the direction of Mr. William Beebe. Mr. Pope's interests lie in the fields of herpetology and ichthyology and his work on the expedition will comprise the collecting and study of fish, reptiles, and batrachians.

About the time these two members of the staff arrived our thirty-eight tons of equipment reached Peking. This equipment consisted of two Fulton motor trucks, which we intend to use as mobile bases when crossing the Gobi Desert, thousands of rounds of ammunition for our shot guns and Savage rifles, tents, camp equipment of all sorts, photographic materials, and the hundreds of small items indispensable for work in various branches of science.

All across the Pacific I had dreaded the task of getting this material from Shanghai to Peking, for the complications of Chinese transportation affecting heavy freight well-nigh drive a foreigner to madness. But I had a pleasant surprise! The Pacific Mail Steamship Company arranged all the details and I had merely to go on to Peking and receive the freight. No one who has not had experience with Chinese railroads can realize what a real service the Pacific Mail Steamship Company rendered the expedition.

Through the assistance of the American Minister, the Hon. Charles R. Crane, we were able to obtain the services of Mr. James Wong as our official interpreter. Mr. Wong was educated in an American military academy and not only speaks English perfectly but has an American viewpoint, which is an extremely valuable asset. Having had considerable experience in the survey of the Szechuan Railway, he is accustomed to handling coolies, and is able to get things done in a shorter time than any other Chinese I have ever met. Since his work was to be at first with Mr. Granger, it was imperative that he should have some preliminary experience in conducting an expedition in search of fossils in a country where the methods employed are totally unlike those in any other part of the world. Dr. Andersson, of the Chinese Geological Survey, very kindly offered to let Mr. Wong accompany him on a short field trip to Manchuria.

On this little expedition Mr. Wong had the good fortune to discover almost immediately a very important cave, which contained the remains of about thirty human skeletons buried several feet beneath its floor. It was at first thought that these were of a Neolithic type, but subsequent investigation has shown that they are very early Chinese. Since Mr. Wong was under Dr. Andersson's direction, the results of his discovery belong, of course, entirely to the Chinese Geological Survey, but the find is evidence of what may be expected in this important field when the vast untouched area which awaits us has been explored.

After considerable discussion with the Survey, Mr. Granger and I became convinced that for his initial work in this new field it would be advisable for him to visit a region where fossils were known to occur. Because a large part of China is so thickly settled and fossil material has in the eyes of the Chinese such a high value for medicinal purposes, and also due to the native superstitions about digging in the vicinity of burial grounds, which in a thickly settled region are necessarily numerous, it is exceedingly difficult to carry on palæontological investigations in this country. When a fossil-bearing bed has been located, it becomes necessary to obtain the consent of the villagers before any excavation can be undertaken and in most cases this is by no means easy.

During the time that Mr. Granger was making his preliminary preparations, I drew up a circular letter in Chinese and in English which was sent to all the resident missionaries and foreigners in the provinces of China where investigations were planned. Replies to a number of these letters have already been received, giving details of fossil localities, some of which are certain to prove of considerable importance. The Survey very kindly invited us to explore a site on the Yangtze River in Eastern Szechuan from which, they learned, many fossils had been excavated. The medicine shops furnished a market for these fossils. The site in question is twenty miles from Wanhsien, above the famous Ichang gorges of the great river. On August 29 Mr. Granger and Mr. Wong, together with several native assistants, left Peking for Hankow, where they boarded a river boat that was to take them to Wanhsien. Above Hankow a local war of considerable proportions was being carried on along the river and I assured Mr. Granger that his initial experience in Chinese fossil-hunting was likely to be far from monotonous. A letter from him, written on September 27, gives some details of his trip.[1]

"Our journey from Ichang to Wanhsien was interesting and exciting. At Ichang we ran directly into one of the inter-provincial wars and had a chance to watch from our decks, or from our stateroom window, quite a lot of fighting on the hills opposite the town. It was necessary to transship here and I managed to get my equipment into one of the steamer 'godowns' before the close-in firing broke out; then managed to get it out again after the up-river boat arrived. . . .

"The 'Lung Mow' left Ichang at daybreak, the city being still in the possession of its defenders, and by breakfast time we were in the first Ichang gorge. A British-American Tobacco Company's man from Nanking and I were sitting on the observation deck, admiring the really magnificent cliffs and congratulating ourselves that at last we were above the turmoil of the war, when suddenly there appeared ahead of us a junk-load of Szechuanese soldiers coming down the river and *bang!* one of them took a pot shot at us. The steamboat siren blew a warning and we had to go below. Four times I was chased off the deck and finally got tired of it and stayed below on the saloon deck. Even then, later in the day, when the firing began to get on the crew's nerves, we were several times ordered below, where we had the protection of the steel hull of the ship.

"About every other junk-load of soldiers we met took at least one try at us. I don't know how many hits they made, but one bullet slipped in past four of us who were sitting on the after-deck, went through the paneling into the dining saloon and fetched up on the linoleum flooring.

"The trouble is that the river boats make such a heavy wash that junks are sometimes sunk and every load of soldiers lost in this way makes just one more black mark against the up-river boats, and there have been several such losses recently. . . . I wouldn't call it a loss, but the soldiers seem to!

"The steamboats in going upstream always slow down when meeting junks, but in coming down they must maintain a steering headway and it is then that most of the sinkings occur. There are warning signals on shore at all danger points, announcing that steamers are approaching from above or below, but the junks mostly ignore these signals and trouble ensues. I suppose it is a question really of whose river it is: with the present total lack of government it certainly isn't China's.

[1]See also NATURAL HISTORY for November-December, 1921, p. 649.

"The steamboats are going to continue to go up and down whenever the stream is navigable and soldiers ought to realize this after a while. There is no sense in transporting soldiers on the river, anyway! If the Szechuanese would stay where they belong, everything would be serene. . . .

"Coming up the river, I was reminded of the title of a book I had seen on sale here in China, *Glimpses of the Yangtze Gorges*—that is what we got! We reached Wanhsien at noon on the second day and I was at once welcomed by Mr. Asker, the commissioner of customs, who asked me to make my headquarters at his place, which is a large temple on the outskirts of the town."

Since the date on which this letter was written there has been no further fighting in the region traversed by Mr. Granger, for the inter-provincial war has been settled, at least temporarily[1] and he has remained at a little village called Yenchingkao, which is in the center of the fossil-bearing region, about ten miles from Wanhsien. A quotation from the latest letter I have received from him, under date of December 26, gives the results of his work up to that time:

"The fossils at Yenchingkao occur in pits distributed along a great limestone ridge about thirty or forty miles in length and rising above our camp more than two hundred feet. These pits are the result of the dissolving action of water on limestone and some of them have a depth of one hundred feet or more. They are of varying sizes, averaging say six feet in diameter, and are filled with a yellowish and reddish mud, which is, I take it, disintegrated limestone. The fossils are found embedded in the mud at varying depths, usually below twenty feet. A crude windlass is rigged up over the pit, and the mud is dug out and hauled to the surface in scoop-shaped baskets. At fifty feet it is dark in the pit and the work is done by the light of a tiny oil wick. It is fossil collecting under the most adverse conditions imaginable.

"The excavation of the fossils has been going on for a long time—possibly for some generations. Digging is done only in the winter months. . . .

"One has to be let down with the rope around his waist and with two or three men at the windlass. The natives climb up and down the rope hand over hand but it requires practice and agility to do this. You'd be shy one palæontologist if I tried it!

"The excavation of the pits is opening up just now on a large scale and in the coming month will probably give us about all that we can take care of. The fauna is *Stegodon*, *Bison*, *Bos*, *Cervus*, *Tapirus*, *Sus*, *Rhinoceros*, besides many small ruminants, several carnivores, large and small, and many rodents: no horses, queerly enough."

The fossils about which Mr. Granger writes in such a matter-of-fact way probably represent an entirely new fauna. From the work of the Chinese Geological Survey and the fragmentary material described years ago by Schlosser, there is evidence of two distinct faunas in North China, probably divided by the Tsingling Mountains of Shensi. To the north of these mountains is what is known as the *Hipparion* fauna, because its most characteristic feature is an abundance of horses. To the south is what might be called the *Stegodon* fauna, for the teeth of this genus of primitive elephants appear to be fairly abundant there.

The Chinese Geological Survey has confined its work entirely to the *Hipparion* beds and we particularly hoped that the Wanhsien locality in which Mr. Granger is working would yield a new fauna. Such appears to be the case and the American Museum may look with confidence to the acquisition of material which, with very few exceptions, will be new.

I feel that Mr. Granger is to be congratulated on carrying on his work under

[1]Developments that have taken place in China since the writing of this article tend to show that the interruption in hostilities was not permanent.

A view in the Tungling, or Eastern Tombs region, where the expedition collected reptiles and fish

Photograph by Walter Granger

Fossil collecting in a loëss cliff not far from Peking the existing conditions. Had I not had complete confidence in his judgment, ability, and coolness in unusual situations, I should have hesitated to ask him to go to this unsettled region on his first trip into the interior of China.

After getting Mr. Granger started for Szechuan, Mr. Pope and I left for a short trip to the Eastern Tombs, or Tungling, as they are known to the Chinese. Here many of the Manchu emperors and empresses are buried in magnificent mausoleums, which stand amidst some of the most beautiful scenery to be found in China. To the north of the tombs, surrounded by a high wall, is an enormous hunting park, more than one hundred miles in length and at least as wide. This park contains rugged mountains, somber valleys, and great forests of birch, pine, spruce, and oak. It is one of the most interesting regions in all China to the zoölogist because it has many species of birds, mammals, and reptiles that were once indigenous to all North China, but that have completely disappeared in the surrounding treeless regions. It stands as a forest island isolated by hundreds of miles of barren country.

The fauna of this region includes many species which are now found only far to the south and also some of those characteristic of the great Manchurian forests in the north. Thus, there is strong evidence that a more or less continuous forest region extended in bygone centuries from the Yangtze River to the northern frontier of Manchuria.

In spite of its beautiful scenery, and in spite of the certainty that many of its species of birds and animals will become extinct when the forest has been cut away, it is being ruthlessly cleared for cultivation as fast as ax and fire can accomplish the destruction. Two years ago I visited the Tungling on a short trip and where now there are waving fields of corn and millet there was at that time a great valley covered with splendid trees.

In order to initiate Mr. Pope into the methods of collecting fish and reptiles in China, and to train three native assistants in the preparation of bird and animal skins, as well as to complete our collections of this disappearing fauna, we prepared for a stay of six weeks in the forests. Our actual trip, however, occupied only half that length of time for we encountered such floods of rain that it was impossible to do effective work. Out of twenty-one days there were only four or five during which we could really collect.

Nevertheless, the trip was successful in its main objects and Mr. Pope learned that instead of having one or two assistants in catching fish and reptiles, he could have a dozen or a hundred, as he wished. Several times we camped in or near a village and sent out word broadcast that we were ready to buy all sorts of living things. The result was that some days we had from one hundred to two hundred specimens of the more common species brought to our camp. Of these we would buy until we had a sufficient number and then, calling a halt on general collecting, we would offer a higher price for the rarer forms, thus encouraging a more discriminating search. In this way we were able to secure an almost complete representation of the reptilian and fish fauna of the region, for at one village we had at least three hundred boys and men scouring every inch of the hills and valleys for snakes and frogs, while perhaps fifteen or twenty fishermen were industriously seineing in the little river which ran in front of our tent. When we returned to Peking, our collections amounted to nearly four thousand fish, reptiles, and batrachians and more than one hundred mammals, several species of which I had not obtained on my former visit to the Tungling.

I judged that Mr. Pope had gained sufficient experience on this trip to enable him to carry on an expedition of his own in a region which was known to be

A cormorant fisherman on the river just outside of Tungchwo along the Eastern Tombs road

rich in reptiles and batrachians and was still inhabited by a goodly number of foreigners who could assist him in "learning the ropes." Therefore, I engaged a cook and native assistants for him, selected his equipment, and arming him with letters to half a dozen foreigners, started him off to the Province of Anhwei in Central China. Unfortunately, the rainy season lasted for an unusually long time and Mr. Pope was almost as badly hampered in his work in the south as we had been in the Tungling. However, after a trip of six weeks he brought back from four thousand to five thousand fish, reptiles, and batrachians, representing the fauna of an unusually interesting region.

Practically no systematic collecting on a large scale of reptiles or fishes has ever been done in China and a vast untouched field thus awaits our investigation. This work is of exceeding importance in determining the life zones, which have greatly influenced human distribution as well as that of the lower mammals.

In connection with Mr. Pope's work we engaged a Chinese artist of exceptional ability, who is making careful paintings of fish, reptiles, and batrachians from life.[1] It is our hope to illustrate in colors as completely as possible the reptilian fauna of all China, for it is our intention to make more or less complete collections in all the eighteen provinces of the Republic. Not only will this material be, with very few exceptions, new to the American Museum, but it will also be unique in the world, for, as I have remarked before, no extensive, systematic investigation and collecting of this type has ever been carried on in China.

[1]The first group of paintings has been received by the American Museum and is referred to in the Notes, pp. 181-82, of the March-April issue of NATURAL HISTORY.

HUNTING WITH THE CAMERA

EXHIBITION OF PHOTOGRAPHS OF MAMMALS AT THE AMERICAN MUSEUM

BY

HERBERT LANG*

STANDING before so representative a series of photographs of mammals as that recently placed on exhibition at the American Museum, one cannot help thinking of the gallant services many of our public-spirited men have rendered in their long struggle to secure the establishment of more national parks and reservations. This exhibition gives a fair record of what is still left for the lover of nature to admire and enjoy in our forests and fields, mountains and deserts, and especially in our national parks and those of Canada; mammals of many other lands are also represented.

Prompted by the desire to encourage a branch of conservation in which the American Museum always has had a deep interest, its president, Professor Henry Fairfield Osborn, offered his enthusiastic and generous support to the organization of this competitive exhibition of photographs of mammals. The immediate response of so many contestants was an agreeable surprise. The great variety of animal subjects shown, the high technical quality of the photographic work submitted, and the interest displayed by thousands of visitors to the exhibition all testify to the success of this nation-wide enterprise.

The inspiring spectacle of endless herds of buffaloes annually stampeding across the vast plains belongs to the past. Millions of westward-pushing men and women have studded the once trackless wilderness with happy homes and fertile fields. Right it was that nature should serve this grandest of projects. Yet this exhibition of pictures, demonstrating as it does a wide interest in wild life, kindles the hope that the mass of our people will lend their aid to the perpetuation of the herds of game still extant by helping to protect the refuges where our sadly depleted mammal life may escape destruction and by encouraging the establishment of additional refuges. The æsthetic value of this collection of more than 1650 photographs is great in itself, and yet of rather secondary importance compared with its educational possibilities.

The game in our national parks is most ably represented by an imposing series of photographs by Norman McClintock, Edmund and Mrs. Hilda Heller, and J. E. Haynes, prize winners in the contest.[1] Their pictures were taken where rifle and gun no longer estrange the game. Bears and hoofed animals, though in practical freedom have so thoroughly learned the value of human friendship that in many instances they have become even tamer than if kept in close captivity. On the other hand there are many stirring sights to be witnessed in our national parks, and the admirable picture by J. E. Haynes of a buffalo herd in full gallop, shown on p. 231 of this issue, must remind many who crossed the continent in olden times of the vast herds that thundered by in unchallenged freedom.

The rigor of winter makes many of the deer lose their last bit of distrust, and so meek have they become, as shown by several photographs, that even children can feed them. These pictures ought to shame the game hog who relentlessly cleans out the last deer from an unprotected tract.

What an enticement salt licks are for deer is no novel experience. Pictures by T. B. Brazil show these animals, after swimming across a wide channel to

[1]A full list of the prize-winning pictures appears on p. 288 of this issue.

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Hardy Island, standing about fearlessly in broad daylight licking their daily ration of salt. Yet we are assured that on returning to the mainland they are as shy as deer are wont to be wherever hunters abound.

A camera is not the only requisite. Of equal importance is a perfect knowledge of the behavior of the animal to be immortalized. That some of the best photographs in the exhibition have been taken by the mammals themselves may appear hardly possible. But even this feat is surpassed, for there are instances where one animal actually has been made to take the photograph of another. Donald R. Dickey of California evidently knew the habits of a pair of foxes well enough to place the bait so as to secure a unique picture. The bait was attached by a string to the shutter and as one of the foxes seized the bait, he unwittingly took the picture of his companion contentedly sitting on a nearby rock.

By the same ingenious means Radclyffe Dugmore and James L. Clark have even made the king of beasts take a flashlight of himself. The lion was caught entirely unawares standing over his prey, a dead zebra. The great progress in flashlight photography in this country and the general impetus given to it is chiefly due to that most successful of pioneers in this line, the Honorable George Shiras, 3d. His patience, endurance, and love of nature have overcome all difficulties with such apparent ease as to give his pictures that particular charm which genius sometimes secures in other lines of art.

An equally enticing sport, and one as harmless, is to follow the peaceful waterways in the forest when the moon sends its glimmer across their surface. Silently gliding along in a canoe, the photographer comes face to face with a doe and her two fawns, a deer quenching his thirst at the water's edge, and a moose enjoying a midnight feast. One of the devices used is jacking: that is, the light of a reflector lamp is turned upon the subject of the search and behind the blinding glare the photographer can approach without fear of being seen.

Of course daylight photography has its own thrills. An outstanding pioneer in this branch is A. G. Wallihan. One of his masterpieces is a picture of an irate cougar forced to leap to earth from a high tree, with paws outstretched and tail in air. To record such a spring in midair with the camera is a rare accomplishment.

A picture of unusual excellence, in the securing of which real courage and daring played a larger part than mere luck, is that of a large herd of African elephants standing in the shadow of an acacia growth, taken by Kermit Roosevelt (p. 234). The unrivaled series of more detailed elephant studies by Carl E. Akeley align themselves into a notable record of achievement. His prize-winning picture of a group of hartebeest (p. 229) is one in which the habits of the animal, tropical luxuriance, and singular chance have contributed in a rare measure to perfection of artistic setting.

However splendid a demonstration the photographs of this contest have given of mammal photography, they tend to prove that pictures of real quality are often the result of a happy combination of ability and luck. Mr. John M. Phillips' fine photograph to which the judges awarded first prize is a case in point. The mountain goat happens to stand defiantly in its own sure way on a sloping abyss in the midst of a chaos of mountain peaks while below are seen the last tops of the timber line. This is a work of art and carries its own inspiring message.

PRIZE-WINNING PICTURES

SELECTED FROM PHOTOGRAPHS OF MAMMALS EXHIBITED AT THE AMERICAN MUSEUM

Copyrighted 1905 by John M. Phillips

MOUNTAIN GOAT
First Prize, Photographs of Mammals in the Wild State
BY JOHN M. PHILLIPS

Copyrighted 1906 by Norman McClintock

WHITE-TAILED DEER
Second Prize, Photographs of Mammals in the Wild State
BY NORMAN MCCLINTOCK

Negative owned by the New York Zoological Society.

CHIMPANZEE
First Prize, Photographs of Mammals in Captivity
BY ELWIN R. SANBORN

HARTEBEEST
First Honorable Mention, Photographs of Mammals in the Wild State
BY CARL E. AKELEY

MOUNTAIN SHEEP
Third Prize, Photographs of Mammals in the Wild State
BY EDMUND HELLER

BISON STAMPEDE

Second Prize, Photographs of Mammals in Captivity

BY J. E. HAYNES

THE EVENING SONG OF THE COYOTE
First Honorable Mention, Photographs of Mammals in Captivity
BY MR. AND MRS. ERNEST HAROLD BAYNES

BAY LYNX
Third Prize, Photographs of Mammals in Captivity
BY W. LYMAN UNDERWOOD

Courtesy of Charles Scribner's Sons

A HERD OF AFRICAN ELEPHANTS IN AN OPEN FOREST

Third Honorable Mention, Photographs of Mammals in the Wild State

BY KERMIT ROOSEVELT

SOME LITTLE KNOWN SONGS OF COMMON BIRDS

BY

FRANCIS H. ALLEN

THE study of bird song is one of the most fascinating departments of ornithology—and therefore of all natural science, as all bird students will agree. It offers most interesting problems to the evolutionist and in another aspect it offers a fruitful field of investigation to those ornithologists who are also musicians and can study its relation to human music. Aside, however, from such large questions as these the mere acquirement of a knowledge of bird notes and songs in all their almost infinite variety is of itself an occupation of unfailing interest. Even if one confines himself to the limits of his own parish, so to speak, the subject is well-nigh inexhaustible. After thirty or forty years of listening to New England birds I am constantly hearing some note that is new to me or some new variation in a familiar song. Within a week[1] I have heard remarkable songs from a rose-breasted grosbeak and a scarlet tanager, both of them belonging to species in whose songs there is commonly but little individual variation. Both these songs had phrases that I should never have thought of attributing to the bird that uttered them if I had not heard the complete songs, which were otherwise quite typical. The grosbeak had perhaps borrowed some notes from a cardinal he had met in the South, while the tanager's new phrase was suggestive of the olive-sided flycatcher's *whee-pū*.

In the matter of individual variation in song, birds differ greatly. A famous example of a species in which individual variation is wide is the song sparrow; another is the Baltimore oriole; but some species with much simpler songs are almost equally variable, as the redstart and the towhee. However, it is not my purpose in this article to say much of individual variation or to speak of songs that are in any way abnormal. I shall confine myself chiefly to songs that are entirely normal, some of which, indeed, are really not at all uncommon and yet for one reason or another seem not to be very well known and to have escaped mention in the popular handbooks. Some of these songs are what are called "whisper songs," others are flight songs, others are certain prolonged efforts uttered in subdued tones during courtship, while still others are regular early morning performances not often heard later in the day. As this paper is intended to be merely a painstaking, and I trust accurate, record of unconnected observations, I make no apology for transcribing largely from my notebooks.

The early morning song of the kingbird (*Tyrannus tyrannus*) seems to have escaped the notice of most bird biographers, but it is quite distinct from the other vocal utterances of this rather noisy bird, though it somewhat resembles the flight song.[2] It is a prolonged, ecstatic, unmusical affair which introduces a phrase suggesting the word *phœbe* at frequent intervals among the chattering. The effect is of a long, continuous song, but perhaps it should be called a rapid succession of short songs. At least so it seemed to me when one July afternoon at six o'clock I found a kingbird singing in the top of a tall elm and made the following notes on the performance: "The song may be written as follows: *De-de-de-de-dzip′-de-de-de-de-dzee-dzee′-it.* The *de-de-de-de* part is delivered in a stuttering fashion. Sometimes the stutter and *dzip* are given twice before the other part or climax (the *phœbe* part) of the song is given. The song is re-

[1]This was written in May, 1919.

[2]I have already published a description of this song (*The Auk*, XXX, 1913, p. 232.)

peated over and over continuously for an indefinite period. With the *dzee'-it* the tail is spread wide. The *dzip* note is somewhat emphatic but the *dzee'-it* much more so." Though heard occasionally at all times of the day, this song is characteristic only of the early morning. It is one of the earliest bird notes, beginning about an hour before sunrise.

Like its relative the kingbird, the crested flycatcher (*Myiarchus crinitus*) is almost as far removed as possible from being a songster in the popular sense of the word. He has nevertheless what, speaking ornithologically, we must call a genuine song. This, again, is chiefly an early morning performance, but may be heard, too, at other times of the day. Like the kingbird's it is a long, indefinite song or series of songs, but it has nothing of the hurried character of the former. Indeed, it is one of the most leisurely songs I know, for there is a rest of two seconds or more after each phrase. In its simplest form the song is a repetition of the phrase *queedle* over and over again indefinitely, but each alternate *queedle* is of different character from the one that immediately precedes it. The first time I studied the song I found numbers 2, 4, 6, etc., to be about a fifth on the musical scale higher than numbers 1, 3, 5, etc.; or, rather, this was true of the first syllable of each phrase—the *quee*. The *dle* part was perhaps a third lower than the *quee* in numbers 1, 3, 5, etc., and about an octave lower in numbers 2, 4, 6, etc. To indicate the difference in pitch I am in the habit of rendering the song *coodle, queedle, coodle, queedle, coodle, queedle*, etc. The *dle* part always being on the same pitch, the inflection of the alternate *queedles* has the effect of a finality in discourse. I think the difference in pitch between the *coodles* and the *queedles* is not always as great as a fifth, for, not being a musician, sometimes I have had to listen rather intently to detect it.

The song is occasionally delivered on the wing, but generally from a perch. It is a strange performance, not unpleasing, especially when one considers the unmusical character of the crested flycatcher's call-notes, and perhaps the most remarkable thing about it is its length and the regularity of the rest between the phrases. Not infrequently a singer will interject syllables like *coo-ick', quee*, with the accent on the second syllable and a brief pause after it and with a tremolo on the *quee*, which is prolonged and has a plaintive and rather pleasing tone, quite unlike the familiar rolling *c-r-r-reep* call-note. Sometimes the *coo-ick', quee* is followed by *coo-ick-quit-it-it-it-it*, loud and emphatic. There seems to be no great individual variation in the main part of the song, but I once heard the lower of the two phrases condensed into a single syllable or nearly so, like the word *quick*, making the song *quick, queedle, quick, queedle*, etc.

Antiphonal singing among birds is rare. Among the very few instances of my hearing anything approaching it, is that of a pair of crested flycatchers at Sherburne, Vermont, among the Green Mountains. One cried *whee-uk* or *quoi-uk* incessantly, and its mate responded with *heek* uttered immediately after, so that the *heek* appeared to belong to the first note, as if both were made by one bird. These were not song notes, strictly speaking, but the performance was of the nature of singing.

The alternating song of the phœbe (*Sayornis phœbe*) is too well known to need description. This bird has also a flight song, consisting of staccato notes and a rapid repetition of *phœbe*.

The wood pewee (*Myiochanes virens*) is another flycatcher with an alternating song and also a flight song. The former—*pe-wee, pee-u*—is, of course, very familiar. The flight song is comparatively rare. I find no description of it among my notes and I have no distinct recollection of it. I have records, however, of having twice heard a low, sweet, trilling, tremulous whistle from the wood pewee, somewhat prolonged but hardly amounting to a song, uttered usually on the wing, just as the bird was about to alight, and accompanied by a fluttering of the wings.

The most remarkable vocal performance of the wood pewee has been described, with musical notation, by Mr. Henry Oldys.[1] I have often heard this song but, not being a musician, I had not, until Mr. Oldys' article appeared in 1904, appreciated its full significance. As I write it in syllables and without the music, it generally goes

pu-wee-wee
pe-wee-ee
pu-wee-wee
pee-u.

As Mr. Oldys shows, it "is constructed in the form of the ballad of human music," and he compares it to the air of "Way Down upon the S'wanee River," in which, as in this song, the first and third lines are identical and the second and fourth differ, the final note of the second line leaving the listener in suspense, but that of the fourth satisfying the musical sense. Mr. Oldys regards this song of the wood pewee as of "higher technical rank than any other known example of bird music." It should be noted that the second and fourth phrases, or lines, are the ordinary song notes, while the first and third (identical) are never given, I think, except as a part of this composition. I once heard a variant of this song which is worth recording. It was in the form of a six-line stanza, thus:

pu-wee-wee
pe-wee-ee
pu-wee-wee
pe-wee-ee
pu-wee-wee
pee-u.

The bird sang two stanzas while I could hear it distinctly and then took up the ordinary *pe-wee-ee, pee-u* song.

[1] "The Rhythmical Song of the Wood Pewee," *The Auk*, XXI, 1904, p. 270–274.

As a musical composer the wood pewee has a rival in the towhee (*Pipilo erythrophthalmus*) or at least in certain individual towhees. On May 24, 1914, near my house in West Roxbury, Massachusetts, I heard one sing over and over again an alternating song that I set down as follows:

jung (low) *dee-dee-dee-dee-dee* (high)
ees-ees (higher) *yŭ-yŭ-yŭ-yŭ-yŭ* (low)

Sometimes there was but one *ees*, oftener (perhaps oftenest) three. A rest of a second or two intervened between the two parts, and after each couplet there was a pause of irregular length, generally a few seconds. The effect, with the ending on a low note, was very pleasing. I have called the song a couplet, consisting as it did of two different variants of the ordinary song of the species, but perhaps it might be regarded musically as a four-line stanza, the first line consisting of a single note. On June 30 of the same year I heard this song again in the woods near by. This time the *ees* was given three, four, and five times in succession, usually five, and the *yŭ* notes were correspondingly reduced in number,—to three generally with the five *eeses*, I believe,—thus preserving the proper length of the line. On July 24, 1916, I again heard alternating songs from a towhee in another locality not far away, but this time the pause between the two parts was longer and there was no such effect of a definite couplet. The performance was less pleasing than that of 1914.

The meadow lark (*Sturnella magna magna*) is another bird that sometimes sings alternating songs,—at least I have heard him do it on two occasions. The second of these was on an April morning in 1915, and the singer was unusually gifted. He had four or more songs in his repertoire. The first, which was repeated a number of times in succession, resembled the opening notes of the white-crowned sparrow's song, but had three high notes on the same pitch, instead of two, before the lower one—*ee-ee-ee-hew*. It was a beautiful song and so different from anything we commonly hear from the meadow lark that I did not suspect its author at first, but thought the bird might be a fox sparrow,—it being too early in the season for white-crowned sparrows. Then the bird began to alternate this song with another which seemed a good musical complement to it. This second song began low and ended high. It was something like *hew-hew-he-hee*, the third note shorter than the others. After a few alternations of these two songs the bird dropped the first and sang only the second a number of times, but dropped that in turn and finally took up two or three simpler and more normal songs, of which one, at least, was sweeter than most meadow-lark songs.

On the last day of February, 1909, I heard strange bird notes coming from a group of hemlocks near my house and traced them to a blue jay (*Cyanocitta cristata cristata*), which, hiding in the very heart of a tree, near the trunk, was singing a long and continuous song of sweet lisping and chippering notes in a subdued tone. Presently he shifted to another hemlock tree and, keeping similarly hidden, went on with his song, but soon stopped, mounted to the top of the tree, repeated a characteristic bell-like note many times, and then flew away. Major C. E. Bendire mentions this song in his *Life Histories of North American Birds*, but it cannot be a very common performance for, though I have lived among blue jays for a dozen years, I have heard it but twice. The second time was in May, 1913.

The hoarse rattle of the crow (*Corvus brachyrhynchos brachyrhynchos*) is well known to all who are familiar with that bird, but it seems not to be generally recognized as a song. That it is actually a love song, however, is indicated by two facts: first, that it is heard chiefly in the spring; second, that it is accompanied by a form of display such as many birds use in courtship. Another vocal accomplishment of the crow, and one of a much higher order from an æsthetic point of view, though it cannot be called a song, is that of cawing rhythmically.[1]

On August 22, 1909, in the town of Norwood, Massachusetts, I found a flock of bobolinks (*Dolichonyx oryzivorus*) feeding in a field of Hungarian grass and circling about from time to time. Some of them kept in trees and bushes, and from these arose a continuous warbling which had at times some resemblance to the regular song of the species, but was on the whole noncommittal. It was not by any means a mere chorus of call notes, but a genuine warbling song, the exact form of which, however (if it had any form) it was impossible to detect on account of the number of birds singing at the same time. It seemed to me very likely that the singers were young of the year, singing a song analogous to the warbling autumnal song of the young song sparrow. The effect of the performance, which was kept up as long as I remained there, was very pleasing. The birds were, of course, in the dull autumnal plumage. The only other time I have heard this song of the bobolink was in the August of the following year, at New London, New Hampshire. Here I found a smallish flock in a cornfield. Some of them were singing this warbling song. This time I could hear it from individual birds. It seemed to have no definite form though it was suggestive of the regular breeding song.

Besides the ordinary song delivered in the familiar trumpet tones in all its infinite variety of melody, the Baltimore oriole (*Icterus galbula*) has an ecstatic mating song of a very different character, longer and warbling, generally interspersed with chattering, and usually much subdued in tone. This, as well as the ordinary song, is sometimes delivered on the wing and it

[1]The reader will find an account of this habit in my note on "The Æsthetic Sense in Birds as Illustrated by the Crow," *The Auk*, January, 1919, XXXVI, pp. 112–113.

is then, I think, louder than when the bird sings it from a perch.

Like the Baltimore oriole the rose-breasted grosbeak (*Zamelodia ludoviciana*) is a brilliantly plumaged bird with a loud song, and like the oriole it has a special mating song uttered in a subdued tone. The grosbeak's is a prolonged utterance and one of the most sensuously beautiful of our bird songs.

On April 20, 1903, I saw a flock of about ten vesper sparrows (*Poœcetes gramineus gramineus*) in West Roxbury, Massachusetts,—a very unusual sight for the time of year. These birds spent a good deal of their time in low trees at the edge of the field and sang a long song that reminded me of the goldfinch's. They puzzled me greatly for a time. Now and then they would fly down to the ground, where they were all clearly vesper sparrows, but when they took to the trees again and sang this long, continuous song, I could hardly believe my senses, the whole performance was so unlike anything I had ever seen in the case of vesper sparrows. Vesper sparrows they were, however, as I determined to my entire satisfaction before I left the place. The flock must have just arrived together from the South and perhaps retained some of their winter habits. Ordinarily the birds are scattered when I first find them in April and are singing their regular breeding song.

On its breeding grounds in Labrador the tree sparrow (*Spizella monticola monticola*), according to Dr. Charles W. Townsend in *Along the Labrador Coast*, sings habitually a shorter and simpler song than the one we commonly hear from it in New England in the spring. Dr. Townsend renders it *seet-seet—sit-iter-sweet-sweet*. I have heard this song on two occasions in Massachusetts, once in Ipswich in company with Dr. Townsend, who recognized it as the breeding song, and a few years later in West Roxbury. On the latter occasion I transcribed it as *sweet-sweet-sweetiter-sweet*, the bird, or birds,—for I thought there were more than one,—having dropped the final syllable.

I suspect that it may not be known to all bird students that the chipping sparrow (*Spizella passerina passerina*) sings every morning in late spring and early summer a song that is not heard at other times of the day; or perhaps I should say that he sings his ordinary song at that time in a very different manner.[1] Having long been accustomed to listen occasionally to the early-morning bird chorus, I have often heard this performance, which consists of a rapid repetition of very short trills following one another in quick succession with hardly a breath between; but one must be awake early to hear it.

On April 13 and 14, 1917, I heard from one or more fox sparrows (*Passerella iliaca iliaca*) near my house a performance comparable to the vireo-like song which is not uncommonly heard from the purple finch. It was a sort of disconnected song composed of the alarm note of the species (the *chuck* or hoarse *chip*) and of sundry chirrups and warbling notes, all short and with considerable pauses between. The effort bore not the slightest resemblance to the fox sparrow's real song, of which, by the way, we had at that time had a feast for a week, the birds remaining about our house and singing freely and finely. It cannot be common, at least in our part of the bird's range, but I know of one other observer who has heard the same or a similar performance.

Though I have seen and heard the cliff, or eave, swallows (*Petrochelidon lunifrons lunifrons*) on many occasions, I have never lived with them, and I have only two or three times heard anything that could be called a song from them. This was at Monhegan Island, Maine, in the first week of June, 1908. The song, as I heard it, was a brief affair, almost identical with a part of the barn

[1]Mr. Horace W. Wright called attention to this habit of the chippy in his paper "Morning Awakening and Even-Song," *The Auk*, July, 1912, XXIX, p. 314.

swallow's song, the least musical part, which, as one ornithologist has pointed out to me, sounds like the twisting of a cork in the neck of a bottle—what Mr. Hoffmann, in describing the barn swallow's song in his *Guide to the Birds*, calls "a very curious rubbery note." If this or any other song of the eave swallow has been described in the books, I have not come across the description.

I have never seen a description of the song of the bank swallow (*Riparia riparia*). As taken down in a colony not far from my house in West Roxbury, Massachusetts, it goes as follows: *chi′-jǐ, chǐ-′jǐ, chǐ-′jǐ, chǐ′-jǐ″-jǐ-jǐ-jǐ-jǐ-ji-iǐ-jǐ-jǐ*, the confused rough trill at the end *diminuendo* and often ascending in pitch a little, the emphatic *jǐ″* rather low in pitch.

The tree swallow (*Iridoprocne bicolor*), like the chipping sparrow, has a special song, or a special manner of singing, for the early morning. As an account of this performance of the tree swallow's seems really to belong in the present paper, I hope I shall be pardoned for quoting myself again and repeating the description I gave of it in an article on the "Morning Awakening."[1] It is that of a bird heard in eastern Massachusetts, May 29, 1904. The bird was singing when I awoke at 2:53 A. M., standard time (3:09, local time). He "sang continuously, apparently without interruption, from the time I first heard him till 3:40. The song came and went, as the swallow flew about over the pond, now nearer, now farther away, now to the right, now to the left, but never stopping, —a constant *tsip-prrup, tsip-prrup-prrup, tsip-prrup, tsip-prrup-prrup-prrup, tsip-prrup-prrup, tsip-prrup-prrup prrup-prrup*, varied only by the varying number of bubbling notes following each *tsip*. The ending of the performance seemed to come gradually. After a period when I heard no song from him—he may have been singing somewhere out of my hearing, however,—I came upon him, or another of the same species, flying about over the land in full song at 3:56. The song was then kept up till 4:05, when I saw the bird perched high on an oak tree, still singing, but after that he allowed his voice short intervals of rest till 4:08, when he flew off and immediately started up the continuous performance again; and I left him still at it." When one considers that not only the voice but the wings also are in constant use thus for more than three quarters of an hour at a time, one can only marvel at the wonderful energy and endurance of the little bird.

Another case of remarkable vocal endurance is perhaps worth mentioning out of the bird's systematic order. I spent a night in mid-July, ten years ago, in a tent on a wooded knoll overlooking a small river that wound through a fresh-water marsh. I got to bed at about ten o'clock, but I got no more sleep than often happens the first night in camp—in fact, I got none at all. However, the wakeful ornithologist on the Stop River in July does not lack for something to listen to—something besides mosquitoes, too. At irregular intervals all through the night a swamp sparrow sang near by, and from 10 P. M. to 3 A. M. two short-billed marsh wrens (*Cistothorus stellaris*) sang steadily, one after the other at intervals of about five seconds. After three o'clock the two wrens rested about a quarter of an hour and then sang more irregularly and less frequently, but the night singing was almost as regular as clockwork. I think they were singing with the same regularity for several hours before ten o'clock, too, but, having then other occupations than listening, I had made no exact observations. Short-billed marsh wrens sang in the meadows all through the following day, but I made no attempt to ascertain how much these two particular birds were singing. This experience was a revelation to me of the tireless energy that can animate a small bird.

I have seen a red-eyed vireo (*Vireosylva olivacea*) interrupt the singing of

[1] *The Auk*, April, 1913, XXX, 233, 234.

his usual song by taking short flights from time to time and accompanying each flight with a song of a very different character, reedy in tone but sweet. This flight song was accompanied by a display of the down of the flanks, which showed also after the bird had alighted.

The yellow-throated vireo (*Lanivireo flavifrons*) has a sweet, rolling trill, pitched rather low and so different from the ordinary song as not to suggest a vireo at all. It seems to be a song-note, if not actually a song in itself, for I have heard it not only uttered independently but as a part of a more elaborate performance. One morning early in July I heard near my house a new song which I traced to a bird of this species. It resembled the flight-song of the red-eyed vireo just mentioned, but this bird was perched. The song consisted of several repetitions of a high-pitched note with rising inflection, suggesting the goldfinch's call-note, but less clear and less prolonged, followed by shorter, indefinite notes and then by the rolling trill, then more of the high-pitched notes, and so on—a sort of continuous performance, perhaps not always in this precise order, but having the trills interspersed with these long and short notes. The characteristic chatter of the yellow-throated vireo was also thrown in occasionally. The bird dropped this song presently and began its ordinary song. In the two succeeding years, about the last of June, I heard at the same place a somewhat similar performance, but not so clearly amounting to a song.

The blue-headed, or solitary, vireo (*Lanivireo solitarius solitarius*), has a rolling trill very much like that of its congener but, I think, somewhat lower in pitch and having, sometimes at least, a falling inflection, whereas, if I am not mistaken, the yellow-throated vireo's trill inclines to run upward at the end. The solitary also varies his ordinary song, the sweetest of our vireo songs, by running the phrases together into a continuous warble.

One afternoon in May I witnessed a curious performance on the part of two catbirds (*Dumetella carolinensis*) that was accompanied by song-notes. I first heard a strange harsh note, which I did not recognize, repeated several times. It suggested a jay's scream with a little of the downy woodpecker quality. This was followed by a sweet, warbled phrase given three or four times; then came the harsh notes, and so on. I thought the bird might be a chat, a rare bird with us, and was surprised when I found it to be a catbird. It was flying about in a thicket, closely pursued by another catbird. The birds kept up the chase for ten minutes or so before I left them, and I don't know how much longer. The singer soon discontinued the harsh notes, but kept up the sweet warbling notes and gave from time to time other song-notes of a catbird character besides the mew, the chatter, and the sharp *chip*, or *hick*, which resembles the brown thrasher's smack. The song-notes were uttered disconnectedly, except that one might be given two or three times in succession, and were frequently given on the wing, perhaps more often so than when the bird was perched. The pursuing bird would sometimes almost strike the singer and alight beyond him, and sometimes would stop five or ten feet short of him. This one was silent, but once, when it alighted near me, I saw it opening and shutting its bill in a threatening manner. The two were on the wing most of the time, I should say, the stops being very short, and they dodged hither and thither among the branches, flying pretty swiftly but keeping inside an area of perhaps thirty or forty feet square, though, so far as cover was concerned, they could easily have taken a wider course. The silence of the pursuing bird made it seem probable that it was a female and that the affair was one of courtship, not of warfare.

Though bluebirds (*Sialia sialis sialis*) nest every year in bird-boxes near my house, I have on only two occasions heard any song-notes from them that differed materially from the ordinary bluebird song. The first time it was a continuous and very sweet warbling whisper song that lasted for some time while the singer's mate was going in and out of a box in which the pair were preparing to set up housekeeping. The second occasion was later in the same season, when a little before four o'clock of a cloudy, cold morning in early June, a bluebird, probably the same one who sang the whisper song, gave his call-note (*tu-wee-wee*) over and over again in rapid succession for a considerable period of time, repeating the performance a little later on the same morning. It impressed me as a kind of morning song, though the individual notes were only call-notes. It is likely, however, to have been a song of distress rather than of love or joy, for it was on that morning that the bluebirds left the box, though it was not till a week later that I learned the real reason for their departure. I had supposed that their young had taken flight, and that they were caring for them elsewhere, but in cleaning out the box I found the dead bodies of the young birds, which had perished from some cause unknown to me. The mournful character of the bluebird's call-note would make it a fitting dirge for the dead, and I am half inclined to think that it was so used on this occasion.

Doubtless my descriptions of these less familiar bird-songs may seem to some readers too minute. Let such readers comfort themselves with the assurance I can give them that I have not always been as minute as I could, but in many cases have condensed my notes to bring them within bounds! Faithful and detailed accounts of everything that has to do with bird-life have, I think, a permanent interest and value. They may furnish a basis for important generalizations in evolution, taxonomy, and psychology and they may also provide data for future studies in the development of the habits and language of birds. We know that various habits of birds have changed with the increase of the human population. May not the notes and songs be subject to similar changes? Published records may help future ornithologists to trace these changes.

And so I excuse myself for what some of my neighbors would call a waste of time, but I suspect that the real reason for this paper is simply that I have enjoyed acquiring these few items of information about our birds, and I now enjoy passing them on to others. I have not exhausted the subject. It is inexhaustible, and I hope that these notes may stimulate others to keep ears on the alert and notebooks open for new observations on the songs of our common birds.

This is a photograph, taken by Mrs. Florence E. Foster, of the yawning mouth of a *Manta*, or giant ray, showing the rows of gill arches. Attached to the upper part of the mouth is the fish known as the shark sucker, which even in death still clings to a region that in life must many a time have afforded it safety

AN ODD PLACE OF REFUGE

THE HABIT OF THE SHARK SUCKER, *ECHENEIS* OR *REMORA*, OF TAKING SHELTER IN THE GILL CHAMBER OR MOUTH CAVITY OF ITS HOST

BY

E. W. GUDGER*

THE shark is notoriously a fish to be avoided and one would think that its mouth cavity is about the last place that another fish would choose for the purpose of taking its ease. Yet, as the title of this article implies, there is a fish, the shark-sucker, that of its own accord and apparently without perilous consequences enters this antechamber of death.

This unusual habit, first mentioned nearly a century ago, has been noted almost a score of times since, but the references to it were made for the most part incidentally in the course of recording other data and have been almost totally overlooked. From time to time I have jotted down such references as I have come across in my reading, intending to use them in a prospective paper on the natural history of the sucking fish. However, they would have lain hidden for some time to come in the great mass of notes accumulated for this purpose, but for the recent publication, under the somewhat misleading title "An Ideal Host," of an interesting observation by Dr. R. A. Spaeth[1] on a hammerhead shark caught at Woods Hole in 1911 and its attendant remora. When an attempt was made to take the latter with a dip net, it dodged very

[1]Spaeth, R. A. "An Ideal Host." *Science*, 1921, N. S. Vol. LIV, pp. 377–78.

*Associate in Ichthyology, American Museum adroitly and finally took refuge in the shark's gill clefts, probably even entering its mouth.

A few weeks later, Prof. H. W. Norris,[1] incited thereto by the above mentioned note of Doctor Spaeth, published a similar observation. While working at the Scripps Institution at La Jolla, California, in November, 1920, he cut off and carried to the laboratory the head of a tuna shark, *Isuropsis glauca*. When this fish was dissected, there fell out of its mouth or gill clefts on to the table a little sucking fish about 75 mm. long. On my writing Professor Norris about this phenomenon he very kindly presented me with this little fish, which will be deposited in the collection of the American Museum.

Although I have had considerable experience with sharks and sucking fish, I have seen on only one occasion the interesting phenomenon recorded by Doctor Spaeth and Professor Norris. I can, however, bear testimony to the difficulty of catching with a dip net a "sucker" that is playing hide and seek with you about a shark's body. Much easier is it to get the wildest squirrel off a tree trunk with the same net. At Tortugas, Florida, on the morning of July 11, 1915, I found on one of my shark hooks a seven-and-one-half-foot *Carcharhinus*, dead. As it was brought into shallow water, three of its four attendant "suckers" deserted it. I then took a dip net and tried in vain to catch the fourth, which glided in the most sinuous and elusive manner over the body, around and under the head, and into and out of the open mouth of the dead shark. Finally, tired of playing with me, it swam off into deeper water. The sucker fish may justly be called the "artful dodger" of the fish world.

The first notice of a sucking fish entering the gill cavity of a shark that has come to my attention is in a paper by W. Foley[2] bearing the extraordinary title, "An Unusual Sea Monster in the Bay" and published in 1835. The "Bay" was the Bay of Bengal. Foley says that: "Several large fish (seemingly Dogfish), about a cubit in length and upwards, were gambolling about the monster, entering its mouth at pleasure, and returning to the water again." The context shows that the "monster" was plainly the whale shark, *Rhineodon typus*, and it is equally clear that the so-called "Dogfish" were sucking fishes. A number of other writers (notably so experienced a seafarer as F. T. Bullen) have similarly confused the remora with the "dogfish." I was inclined to criticize such errors until I once made the same mistake while trying to land a ten-foot tiger shark and its attendant "dogfish" in the clear waters at Key West, Florida.

The next record of this curious habit of the sucking fish that I have noted is from the pen of William Thompson[3] in 1846, who writes as follows:

> "A letter from Mr. R. Ball, dated Dublin, July 29, 1846, informed me that Mr. N. A. Nicholson had that morning brought him a fresh specimen of this fish [*Echeneis remora*] which he had found adhering to the gills of a large shark, which with the aid of a fisherman he captured at Clontarf, Dublin Bay, on the preceding night; it was observed in shallow water and driven ashore. A second Remora was adherent to the gills at the opposite side, but when disturbed, it made its way inwards by the branchial orifices, and was not seen again. Mr. Ball afterwards obtained the fish on which the Remora was found; it was a blue shark (*Carcharias glaucus*) of a beautiful blue color, and ten feet one inch in length."

Thompson seems to have gone carefully into this alleged discovery and was so thoroughly satisfied of its authenticity that he incorporated the above account in his *Natural History of Ireland*, London, 1856, Vol. IV, p. 222. This account was later copied by Sir John Richardson, as editor of the third edition

[1]Norris, H. W. "Shark and Remora." *Science*, 1921, N. S., Vol. LIV, p. 465.

[2]Foley, W. "An Unusual Sea Monster in the Bay." *Journal Asiatic Society of Bengal*, 1835, Vol. IV, p. 63.

[3]Thompson, Wm. "Additions to the Fauna of Ireland," etc. *Annals and Magazine of Natural History*, 1846, Vol. XVIII, p. 314.

of William Yarrell's *History of British Fishes*, London, 1859.

The next account chanced upon is from the pen of the eminent Cuban ichthyologist, Felipe Poey,[1] who writes (1856) as though the matter were one well known to all students of fishes. After noting that *Echeneis guiacan* is too large to enter the gill cavities of its host as its smaller relatives do, he says that "They [the echeneids, or striped sucking fish] have the instinct of fixing themselves on the gills and under the operculum [of their hosts], and it is pretended that they take their part of the prey as the fish swallows it." Of the *Echeneis osteochir* of Cuvier, (his *E. tetrapturorum*), he says that "one finds it only on the *Tetrapturus* [Swordfish], hidden almost always under the opercular apparatus." Of the *E. sphyrænarum*, of which he had one specimen 75 mm. long, he writes, "This little *Echeneis* has up to the present time been found only on the *Sphyræna picuda*, where it conceals itself among the gills and slips out of these when the large fish is taken." There can be no doubt that Poey knew what he was writing about, and later abundant corroboratory evidence as to the practise of this habit will be produced for at least one of the species referred to.

The next contribution to our subject is made by C. F. Lütken[2] under date of 1875. In the course of an extensive and able paper on echeneids, he notes that an *E. remora* in the large collection studied was taken from the mouth of a tiger shark, *Galeocerdo tigrinus*. Of the light colored form, well named *E. pallida*, he had two specimens taken from the mouth of a *Tetrapturus* (swordfish) captured in the south Atlantic (3° S. and 29° W.)

In another[3] paper published two years later (1877), Lütken refers to this phenomenon as one well established, and specifically says that *Echeneis pallida* is habitually found in the gill cavities of the round-snouted swordfish. He writes that other specific "suckers" will probably be found on certain definite teleostean hosts.

H. C. Yarrow,[4] whose valuable studies of fishes were made in the waters which comprise the harbors of Beaufort (where the laboratory of the United States Bureau of Fisheries now stands) and Morehead City, North Carolina, and the adjacent Bogue and Core sounds, Beaufort Inlet, and near-by parts of the Atlantic, obtained from the fishermen a few small specimens of the true remora, the brown form. The fishermen told him that these were found in the mouths of sharks. My own experiences with sharks in these same waters unhappily brought me no such fortunate observation.

E. P. Ramsay[5] writing in 1881, of a great swordfish, *Histiophorus gladius*, 13 feet 4 inches long from the tip of the sword to the center of the hind edge of the caudal fin, says: "Under the gill-cover we found a small sucker-fish (*Echeneis*) of a pale pink color, about 8 inches in length." This swordfish was taken off the coast of New South Wales, and we see, therefore, that this remarkable kind of symbiosis is found between "sucker" and swordfish in south Pacific as well as in north Atlantic waters.

The next records bring us back to the whale shark. In a letter sent to the eminent ichthyologist, A. C. L. Günther, Signor G. Chierchia,[6] commander of the

[1]Poey y Aloy, Felipe. *Memorias sobre la Historia de la Isla de Cuba*, etc., Havana, 1856, Vol. II, pp. 248–256.

[2]Lütken, C. F. "Ichthyographiske Bidrag; V, Museets Sugefiske (Echeneidæ)." *Videnskabelige Meddelelser Naturhistoriske Forening*, Copenhagen, 1875, pp. 37 and 39, French résumé, pp. 4–5.

[3]Lütken, C. F. "Fire Hojsofiske; II, Lodsfisken og Sugefisken." *Tidsskrift Populære Fremstellinger Naturvidenskaben*, Copenhagen, 1877, 5. Række, No. 4, Vol. XXIV, pp. 368–369.

[4]Yarrow, H. C. "Notes on the Natural History of Fort Macon, N. C., and Vicinity." *Proceedings Academy Natural Sciences of Philadelphia*, 1877, Vol. XXIX, p. 212.

[5]Ramsay, E. P. "Notes on *Histiophorus gladius*." *Proceedings Linnæan Society of New South Wales*, 1880, Vol. V, 295–297.

[6]Chierchia, G. "The Voyage of the 'Vettor Pisani.'" *Nature*, 1884, Vol. XXX, p. 365.

Italian exploring ship, "Vettor Pisani," describes the capture of a great *Rhineodon* in the Gulf of Panama in 1883. Of most interest to us here is his statement that:

"While the animal was on board, we saw several Remora about a foot long drop from his mouth; it was proved that these fish lived fixed to the palate, and one of them was pulled off and kept in the zoological collection of the ship."

Kamikichi Kishinouye[1], the Japanese ichthyologist, in 1901 described a specimen of *Rhineodon* taken off Cape Inubo, Japan. He did not see the specimen previous to its being mounted, but said that the purchaser and mounter told him that it was covered with sucking fishes and that one was found in its stomach. Now the oesophagus (throat) and stomach of a shark are separated by what in our childhood days we learned was the demarcation between the northern and southern hemispheres, "an imaginary line," and we may perhaps be allowed to think that the sucking fish above mentioned was found in the throat of its host.

While we are in the western Pacific, let us next go to the island of Formosa, where it is recorded by G. L. Mackay[2] that in the estuary of one of the rivers a shark was found floundering about helplessly. "We surrounded and secured him, and found a remora about six inches long in his ear. This little creature had power to make the monster of the sea utterly stupid."

The "ear" is, of course, one of the gill slits, and the floundering and stupidity were due entirely to causes other than the presence of the sucking fish. But it is interesting to note in this connection that in the Arabic *Chain of Chronicles* and in the writings of Ad-Damîrî we have accounts of a sucking fish which attaches itself to the "ear" of the whale and produces similar effects. The first of these accounts reads as follows:

"This [previously referred to] large fish is called *al-wal*. In spite of its size it has for its enemy a fish only a cubit in length, called *el-leshek*. When the large fish becomes angry and attacks the other fishes in the sea, the little fish takes charge of him; it attaches itself to the root of his ear and does not let go until he is dead."[3]

Al-wal is identified as the sperm whale, which is common in the Indian Ocean, especially in the western parts. It is called *bal* by Ad-Damîrî, who says of it:

"When it begins to tyrannize the other animals of the sea, God sends a fish about a cubit in length, which attaches itself to its ear, and the *bal* seeing no means of freeing itself from it, goes down to the bottom of the sea, and strikes its head on the ground until it dies."[4]

One would think that the sucking fish would with more likelihood find a resting place in the capacious cavern of the whale's mouth, and the above accounts probably originated in the observation of such a habit. That the habit obtains, we have the testimony of Frank T. Bullen[5], who in one of his charming books speaks of "The sucker's delightful quarters in the mouth of the right whale, adhering to the palate with its head pointing in the direction from whence the whale's food enters." It is probable that if works on the natural history of the whale were carefully perused, many such accounts could be registered.

But if found in the mouths of giant sharks and whales, why is the sucking fish not similarly found in the buccal cavities of great rays? The answer is that it is so found in the mouth of the greatest of all rays, *Manta birostris*. The earliest account of the capture of this great ray in our waters and its first accurate description were read before the Lyceum of Natural History of New York by Dr. S. L. Mitchill[6] on September 15,

[1] Kishinouye, Kamikichi, "A rare shark, *Rhineodon pentalineatus*, etc." *Zoologischer Anzeiger*, 1901, Vol. XXIV, pp. 694–695.

[2] Mackay, G. L. *From Far Formosa: the Island, Its People, and Missions*, Chicago, 1906.

[3] Reinaud, J. T. *Relations des Voyages Fait par les Arabes et les Persans dans l'Inde et à la Chine dans le IXe Siècle de l'Ère Chrétienne*, Paris, 1845, Vol. I, p. 2 f.

[4] Ad-Damîrî's *Hayat al-Hayawan* [a zoölogical lexicon,] translated by A. S. G. Jayakar. London and Calcutta, 1906, Vol. I, p. 237.

[5] Bullen, F. T. *Denizens of the Deep*, Chicago, 1904.

[6] Mitchill, S. L. "Description of a New and Gigantic Species of the Genus *Cephalopterus*, of Dumeril" [*Manta* of other writers]. *Annals Lyceum of Natural History of New York*, 1824, Vol. I, p. 28.

1823, and published the following year. From his account we learn that a specimen of this ray, taken off the entrance to Delaware Bay, was attended by a number of satellites and that "One of them was seen to enter the mouth and pass out familiarly and easily through the ears [spiracles] and gill openings."

Recently, I was able to put on record[1] the taking of a full grown *Manta* off Block Island in August, 1921, with a sucking fish adhering to the upper part of the mouth. Fortunately for science Mrs. Florence E. Foster, an expert photographer, was at Block Island at the time engaged in getting a series of moving picture films showing the episodes incident to fishing for swordfish. She made a number of pictures of this *Manta* when it was brought to shore, and has kindly presented to the department of ichthyology, American Museum, a full set of these. Of particular interest is her picture of a "sucker" affixed to the mouth of the ray, which is reproduced on the first page of this article. It is believed that there is no other picture like it in the world.

But we have gotten far away from the little "suckers" which parasitize (in the view of most observers) the great barracuda and the greater swordfish. With the final discussion of these, our account of the curious habit of the remora will be concluded.

First comes my own personal experience. At Tortugas, Florida, on July 4, 1914, the yacht "Anton Dohrn," of the Marine Biological Laboratory of the Carnegie Institution of Washington, made a dredging cruise off the northwest rim of the atoll. Anxious to get large specimens of *Sphyræna barracuda*, I went along well supplied with trolling lines. One of these was presently brought in with a barracuda 41 inches long safely hooked. When the barracuda was finally quieted by being knocked on the head, there was found adhering to the deck near the barracuda the smallest striped sucking fish (*Echeneis*) that I had ever found. It was only about $3\frac{1}{2}$ or 4 inches long and had a plumose instead of a slightly concave tail. It was carefully detached from the deck, put in a jar of sea water, and a little later introduced into an aquarium of running salt water at the laboratory. It was now late in the afternoon and as the little fish seemed rather exhausted after its experiences, its examination was unfortunately deferred until the next morning. But when morning came, great was the disappointment, wrath, and profanity, when the little fish could not be found in the aquarium, in the discharge pipe, on the floor, or on the ground outside. Since all the other fishes in the same aquarium were smaller than the little "sucker," the mystery of its disappearance is unsolved to this day, as is the question whether or not it was a specimen of Poey's *Echeneis sphyrænarum*, the "sucker of the barracuda."

In the course of the following year I obtained, through the courtesy of Mr. Peter Roberts, keeper of the fish market at Key West, Florida, what is probably the largest collection of small striped sucking fish in the world. There are thirty-four of them ranging in length from about 4 to 8 inches. These were brought to Mr. Roberts by fishermen, who got them from large barracudas, groupers, jewfishes, etc. I have no doubt that many of these were taken from the gill cavities of their hosts, but unfortunately no records could be obtained.

When Mr. Louis L. Mowbray went from the New York Aquarium to Miami, Florida, to take charge of the magnificent new aquarium and laboratory there[2], I asked him to watch out for little sucking fishes on his big fish and on those brought in by sportsmen. This he has kindly done and has sent me specimens taken in 1920 and 1921. Among these is a little striped sucker, apparently a dead match

[1] Gudger, E. W. *Science*, March 31, 1922, N. S., Vol. LV, No. 1422, pp. 338-340.

[2] See NATURAL HISTORY, July-August, 1921, pp. 356-366.

for my last specimen, taken from a barracuda, but not from beneath the operculum. Indeed, Mr. Mowbray's experience unfortunately coincides with mine,—neither of us has ever found an *Echeneis* thus located. This does not mean, however, that the *Echeneis* does not penetrate under the operculum, and I confidently expect that later Poey's statement will be confirmed,—all the more because Mr. Mowbray writes that he has taken another "sucker" (*Rhombochirus*) from the gill cavity of the barracuda. This, of course, may be the fish to which Poey refers. Careful study of all the forms will be necessary to determine this point.

Mr. Mowbray has, however, taken from the gills of both the sailfish, *Tetrapturus*, and the sunfish, *Mola* (*Orthagoriscus*) *mola*, specimens of a sucking fish which he places in the genus *Rhombochirus*. These he has courteously sent me for the collections of the American Museum. Those attached to the sunfish were about 8 to 10 inches long, and were for a considerable time after their capture kept on exhibition in one of the tanks of the Miami Aquarium. In fact, I fell heir to them only after their decease from natural causes.

Zane Grey's delightful book, *Tales of Fishes*[1] is a mine of information on the habits of swordfishes found in both California and Florida waters. Mr. Grey undoubtedly knows more about the ways of these fishes than any man in the world to-day. The most remarkable and spectacular of their habits is that of leaping high out of the water. The chief purpose of this leaping is, in his judgment, to shake off the remoras, which adhere to them in numbers. The particular kind of remora associated with swordfishes is pale in color, and this may be due, Mr. Grey thinks, to the fact that the remora lives under the gill covers of the swordfish and therefore is not exposed to the light. Creatures not so exposed—for instance those living in caves—are nearly colorless. Mr. Grey says that when the swordfish is brought to the gaff, remoras are frequently found under its gill covers, undisturbed apparently by the hard fight, extending over hours, that their host has been engaged in, trying desperately to escape.

These experiences of Mr. Grey were chiefly obtained around San Clemente Island, off the coast of southern California, and are confirmed by my friend, Mr. Van Campen Heilner, of Spring Lake Beach, New Jersey, who has lately returned from a fishing cruise in the waters about Santa Catalina and San Clemente. Writing of his experiences at the latter island, he says that he found no marked differences between the sucking fish which he obtained from the gill cavity of the marlin swordfish of San Clemente and that from the sailfish of the Florida coast. He has found generally from two to five "suckers" on the gills of each swordfish and he believes with Mr. Grey that the swordfish leap in the endeavor to shake off their attached guests.

Mr. Heilner writes further that he has taken "suckers" from the gills of various kinds of game fishes, mainly swordfishes, but "with sharks running a close second." These fishes have all been small and brown in color, probably a distinct species. Specimens are now being collected with a view to determining this point.

As to the purpose of the sucking fish in penetrating the gill chamber or buccal cavity of its host, it is plain that there can be but one explanation. It goes there for protection. Nor does this seem to be a dangerous pastime for the smaller fish. If the shark were so minded, it could easily snap up its attendant "sucker," as it could also its so-called pilot fish (*Naucrates ductor*). However, these fish seem practically immune. Holder[2] relates a case where the shark was virtually invited to take a remora but disdained to do so. He

[1] Grey, Zane. *Tales of Fishes*, New York, 1919.

[2] Holder, C. F. *The Log of a Sea-Angler*, Boston, 1906, pp. 127–128.

says: "One I hooked not three feet in front of the shark's nose, where it coiled like an eel for a few seconds, doubling and struggling, yet the shark apparently did not notice it."

So far as known to me there are, excluding Kishinouye's doubtful case referred to above, only two accounts in the literature of sharks or shark suckers of remoras swallowed by sharks. Holt and Calderwood[1] in a paper dated 1895 record that in the stomach of a specimen of the picked dogfish (*Acanthias vulgaris*) were found the head and shoulders of an *Echeneis remora*. Since this remora was bitten in two, it would seem to have been attacked and captured by the dogfish, which, it may be remarked, is a shark too small to have any "sucker" attendant unless it be a very small one. The other instance is related by Holder.[2] Many years ago on the outer Florida reef he tried the experiment of catching a shark with a remora having a cord tied around its tail just in front of its caudal fin. This experiment was a failure; on the other hand, "one tossed at a shark was seized by the latter that doubtless thought it a votive offering."

My own experience tallies with that of others that the shark does not hurt its attendant sucking fish. I have caught a considerable number of sharks, a fair proportion of which were accompanied by these symbiotic companions. Practically all the sharks were dissected and their stomach contents noted. Fish fragments were often found, but remains of sucking fish never.

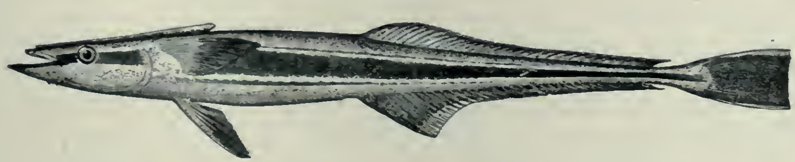
Finally, it may be noted that in one of the large tanks of the New York Aquarium there is on exhibition a five-foot sand shark with an *Echeneis* about 15 inches long. Although host and attendant have been joint occupants of the same tank for about nine months, the shark has never made any attempt, so far as noticed, to capture its companion in this strange symbiosis. Whenever I have visited the Aquarium, I have seen the "sucker," like an "old man of the sea," riding around clinging to the shoulder region or flanks of its host.

Perhaps the term "symbiotic companion" as applied to the "sucker" may be incorrect, since strictly in a true symbiosis each companion helps the other. Perhaps the word commensal fits the case better, for it seems probable that the remora eats the "crumbs" that fall from the jaws of its larger messmate.

When one reads of the remora penetrating the mouth cavity of the shark, one recalls the saying about the lion and the lamb. Certainly no more strange and interesting case of association on the part of animals of diverse habits and manner of living presents itself than that of the savage and voracious shark and the defenseless and retiring remora.

[1] Holt, E. W. L. and Calderwood, W. L. "Survey of Fishing Grounds, West Coast of Ireland, 1890–1891. Report on the Raıer Fishes." *Scientific Transactions Royal Dublin Society for 1893–96*, 1895, 2. Ser., Vol. V, p. 413.

[2] Holder, C. F. "The Remoras." *Scientific American*, 1905. Vol. XCIII, p. 163.



The striped sucking fish, *Echeneis*, which takes refuge in the gill cavity or mouth of its host

The leaf-cutting bee, *Megachile*, may be induced to build in structures prepared for its reception. One of these bees is seen on the left of the picture closing the entrance to her nest, which is constructed in a deep hole augered at the point of junction of two boards. Subsequently the two boards were unscrewed, laying bare the workmanship of the bee. Several of the neighboring holes, and others not shown in the picture, have been sealed by a potter wasp (Eumenidæ)

AN EXPERT INSECT ARTISAN

SOME RECENT INTERESTING OBSERVATIONS ON THE LEAF-CUTTING BEE MADE BY WILLIAM M. SAVIN

WHEN we mention the bee, we are apt to refer to the honey bee (*Apis*)—an insect which, because of the nice division of labor within its hives, the unquestioning spirit of coöperation that pervades these, and the reckless sacrifice of the individual in the interests of the community, has from old appealed to the thoughtful and, like the ant, has been recommended to laggards and individualists of the human race as a creature the behavior of which was worthy of emulation. Yet there are many other bees besides *Apis* and comparatively few of these are, like *Apis*, social—indeed, in our latitude the only other bees that live in colonies are the bumbles and in their case, the nest is founded by a solitary, fertile female in the spring of the year, and only later in the season becomes a coöperative undertaking, dissolved in turn with the coming of winter. Most bees are solitary and a few—destroying our conception of the bee as a symbol of industry—are even parasitic, laying their eggs upon the stores gathered by others.

Of the solitary bees, those of the family Megachilidæ offer many points of interest. They differ from all the other families of bees, solitary as well as social, in having their pollen-collecting device on the underside of their abdomen instead of on their third pair of legs. If one of the females of this family be examined—it will necessarily be a dead one, for all bees save the stingless Meliponidæ of the tropics are armed with a weapon of defense the sharp thrust of which man is glad to avoid—a brushlike covering of hairs will be noted on the ventral surface. Often such a brush is beset with pollen, indicating its purpose.

It is, however, on account of their nest-building habits rather than their structure, interesting as this is, that these bees deserve a word of emphasis. Some members of the family construct their cells of flocculent vegetable fiber, which the female scrapes with her toothed mandibles from certain plants. Within this woolly covering, which has been provisioned by the mother, the larva upon hatching develops, passing into the pupal stage and from that into the adult before emerging from its downy investiture. Certain other members of the family use harder building materials to separate the cells that they place one on top of the other, usually within some more or less cylindrical hollow, such as is offered by the easily excavated stems of brambles. Strange nesting sites are sometimes chosen: keyholes have occasionally been occupied; empty snail shells are tenanted by several genera; plant galls have provided a domicile. A flute carelessly left in a garden has offered the charms of home. It is even recorded that, impervious to its dangers, these adaptive insects have built their nurseries in the barrel of a gun.

Yet of all the nest-building habits, that of *Megachile*, the type genus of the family, is perhaps the most interesting, for with a precision so astonishing that its products seem to be the work of an artisan with an assortment of tools, the female with her mandibles snips out of the leaves of various plants, notably those of the rose, circular, oval, and semi-oval particles, which she bears off to some tubular hollow selected as a nesting site and there pieces together into little thimble-shaped compartments. These are placed successively, each housing an egg with the provender upon which the subsequently emerging larva will feed. So nice is the construction of these cells, so effective the reënforcement received from successive leafy envelopes, that the contained food paste is firmly imprisoned and at the service of the insect inmate. The longer particles are used for the construction of the cylindrical body, the circular particles are used to close the orifice at the top and are somewhat larger in diameter than the thimble itself, being fitted over it and pressed down into it, thus forming a tight, concave roofing.

Wonderful indeed is the product of this workmanship, and it is not altogether surprising that in other less enlightened ages individuals should have viewed these leafy thimbles with awe and even terror as a work of necromancy. Réaumur, the eighteenth century entomologist, inventor of the thermometer that bears his name, tells of a gentleman, who in 1736 came to see a certain Abbé Nollet, being accompanied, among other domestics, by a gardener who had a very bewildered manner. This gardener had traveled all the way from Rouen to Paris to report to his master that a spell had been cast on his land. As evidence, he had had the courage—for courage was needed to carry out such an action—to take certain peculiar rolls of leaves he had found in the earth, which had convinced him and his neighbors that diabolical forces had been at work and which, he believed, would carry a similar conviction to all the rest of the world. Upon viewing the rolls the master was, however, not as terror-stricken as the gardener had expected him to be. If he was not wholly calm, he was optimistic enough, at least, to believe that some natural explanation would be found. A doctor who was consulted regarding the phenomenon was unable to shed light upon it but advised that it be brought to the attention of Abbé Nollet, as one well able to decide whether natural history offered any parallel to the case. To Abbé Nollet accordingly they went and without delay the gardener placed before his eyes the rolls of leaves which he had been able to attribute only to sorcery. Fortunately the Abbé had with him other rolls of leaves fashioned by beetles. He showed them to the gardener and assured his visitors that these rolls were made by insects and that other insects were doubtless responsible for those which caused the gardener so much disquiet. He at once undid some of the rolls which had seemed so forbidding to the peasant and from the interior of one of them drew forth a fleshy larva. As soon as the peasant beheld it, his frightened manner disappeared and an expression of relief spread over his face as though he had been rescued from some overshadowing danger.

Cylindrical holes in the earth are not the only nesting sites of the *Megachile.*

Professor Comstock states that he has found cells of *Megachile* "in a crack between shingles on a roof, in the cavity of a large sumach, beneath stones lying on the ground, and in Florida in the tubular leaves of a pitcher-plant." Taking advantage of this catholicity of taste, Mr. William M. Savin tried the interesting experiment below recorded, offering the insect specially constructed nest sites, in order to induce it to work under his very eyes.

"It is not an easy matter," writes Mr. Savin, "to find the bees at work in nesting sites offered by nature because these sites are scattered and difficult to detect. One day I chanced to notice a *Megachile* building a nest in a hole in the bottom of a shutter and judged, therefore, that these insects were anxious to discover nesting hollows and might make use of artificially prepared ones. Accordingly I secured two boards of like size, laid them one upon another, and screwed them together. At the line of junction of the boards, holes were then drilled to a depth of about five inches. These holes were of two distinct diameters, namely, five-sixteenths and six-sixteenths of an inch, the purpose being to see whether the bees would exercise any preference. The experiment proved enlightening. Only after the holes that were five-sixteenths of an inch in diameter had been occupied, did the bees use the larger excavations. When the nests were constructed, it was a simple matter to lay them bare by unscrewing the boards. Every time the boards were put out the bees promptly found them and were building nests within a day.

"The circular and oblong pieces of leaf used for cell construction vary in number. In cells opened by me they ranged from three to eighteen and from twelve to twenty-four respectively. When a large number of circular particles were used, only a small number of oblong shape were employed, and conversely. The number of pieces seemed to vary according to the individual bee, but when a cell contained a certain number, the contiguous cells had about the same number.

"Some cells were built of an unusually small number of leaf cuttings—for instance, four circular and sixteen oblong. On the other hand, in a hole five-sixteenths of an inch in diameter, sheltering a nest of five cells, each cell was composed of eighteen circular and twelve oblong pieces—a total of one hundred and fifty—and to fill a vacant space between the last made cell and the entrance to the nesting hole, forty-eight circular pieces were used, total one hundred and ninety-eight. In a hole three-eighths of an inch in diameter, housing a nest of six cells, each cell contained six circular and twenty-four oblong pieces, one hundred and eighty in all. A vacant space of one and three-fourths inches between the last made cell and the entrance to the nest was filled in this instance with ninety oblong pieces.

"With nothing to guide her but her instinct the bee is able to cut pieces of proper size for the several holes, those intended for the holes six-sixteenths of an inch in diameter being noticeably larger than those used in the smaller holes.

"The time required for the performance of her several duties varies greatly. I have seen a *Megachile* leave her nest for a cutting from a plant fifteen feet distant and return to it in a minute, and another *Megachile* go to some plant farther away, the place unknown to me, and return with a cutting in one half minute. On another occasion a bee of this genus would take fifteen minutes, some difficulty possibly arising in securing a desirable plant. Often the cuttings were arranged in a cell in a minute, at other times several minutes were required. The average was two minutes.

"Often on returning to her nest in the board a *Megachile* would enter the tunnel of one of her neighbors, but quickly withdrawing, she located her own without further mistake. The situation was a puzzling one, for there were nine holes in a row separated by spaces of only about two inches each.

"A few cold days in early October caused all work to cease. Several days later, on uncovering the nests, I found only a few cells in each nest properly sealed. The bees were soon to die, but their instinct prompted them not to use the nesting burrow for a grave."

THE WORKMANSHIP OF THE LEAF-CUTTING BEE

REPRODUCTIONS FROM PHOTOGRAPHS

BY

WILLIAM M. SAVIN

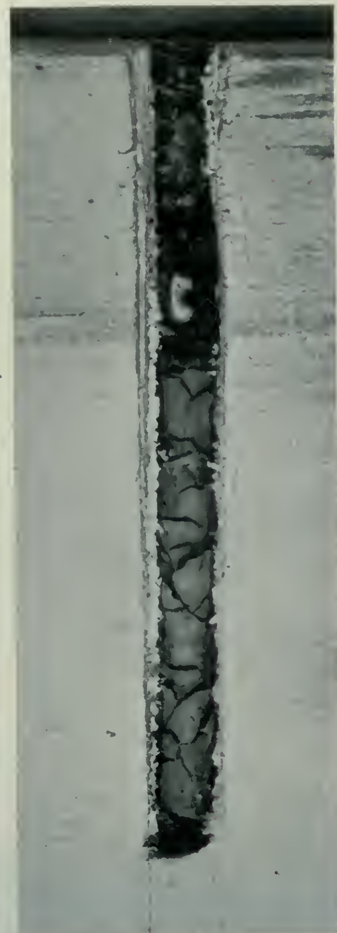
The leaf-cutting bees, *Megachile*, are rather partial to rose leaves but those of the Japanese rose (*Rosa rugosa*), which are thick and wrinkled, are apparently taboo to them. Sometimes, however, they use the petals of this flower, making circular as well as oblong cuttings. The oblong particles are used to form a thimble-shaped cell and the circular ones for closing it after nectar and pollen have been gathered and placed in the cell as food for the larva that will emerge from the egg that the bee lays

So partial are the leaf-cutting bees to the panicled tick trefoil (*Desmodium paniculatum*), that sometimes the leaves are mere skeletons when the bees are through with their cuttings

The leaf-cutting bee not infrequently uses the leaves of the locust (*Robinia pseudacacia*) and of the climbing false buckwheat (*Polygonum scandens*). Occasionally the bee appears to be dissatisfied with the shape of the cutting and fails to finish and remove it. The abandonment of the task is clearly indicated in the case of one of the buckwheat leaves above

On rare occasions the leaf-cutting bee secures cuttings from staghorn sumac (*Rhus typhina*), red ozier dogwood (*Cornus stolonifera*) and Judas tree (*Cercis canadensis*)

Along a woodland path were found small specimens of white ash (*Fraxinus americana*) and a sharp-leaved goldenrod (*Solidago arguta*), from the leaves of which particles had been snipped by *Megachile*. A leaf of a pink knotweed (*Polygonum pennsylvanicum*) found elsewhere and similarly mutilated is also shown. It is unusual for *Megachile* to use these leaves



(Left). Rose leaf showing where circular and oblong cuttings have been taken from the leaflets by *Megachile*

(Center). Nest of the bee, consisting of five cells constructed of leaf particles. The cell nearest the entrance, opened for the purpose of the picture, shows the grub. Between that cell and the entrance the bee had placed forty-eight circular pieces of leaf for packing

(Right). The thimble-shaped cells of the bee are here shown detached from the nest. Each cell is stocked with nectar and pollen, which the bee works into a mass for the subsequently emerging larva to feed upon. The cell is sealed with circular pieces of leaf. The parent never sees her offspring

An interior view of the structure shown on p. 250. The nests (three in all) have been laid bare through the removal of the upper board. The completed nest consists of six cells fashioned out of a total of one hundred eighty pieces of leaf, and between the last-made cell and the entrance the bee placed ninety pieces for packing. The entrance to the vacant hole and the entrance to one of those occupied by a *Megachile* were sealed with mud by a potter wasp (Eumenidæ), which apparently wanted no neighbors. Several adjacent nest hollows were similarly sealed by this obstructive insect, as indicated in the picture on p. 250

Courtesy of the Department of the Interior, Canada

In contrast to the grassy plains of our Middle West, which one is apt to think of as the typical roaming ground of the bison, timbered country of the character of that shown above is the favored haunt of the wood bison

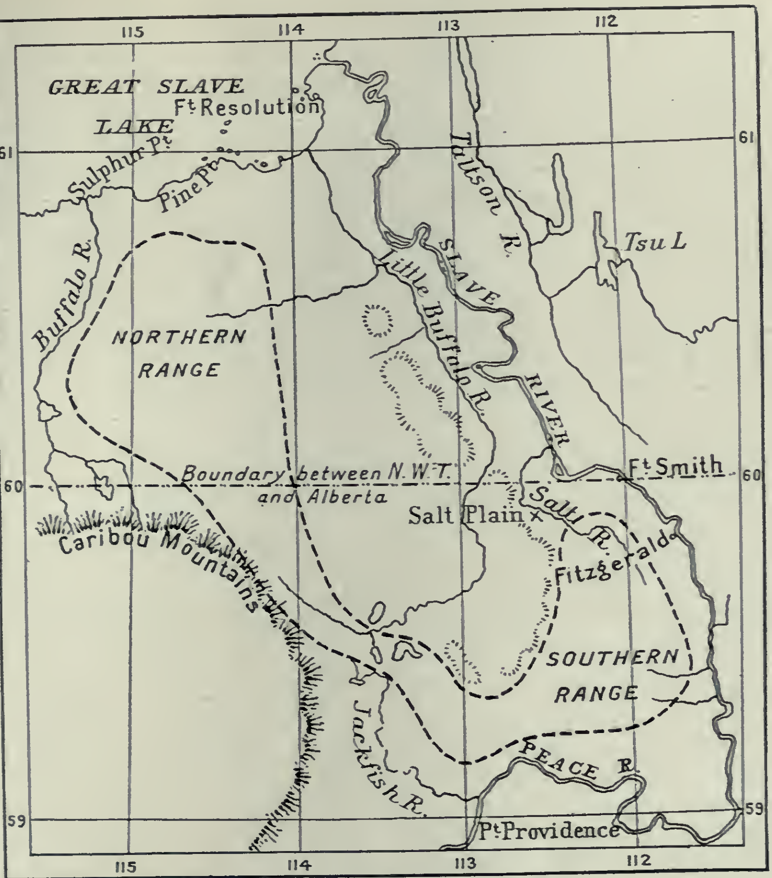
THE WOOD BISON OF CANADA

LAST WILD REMNANT OF A ONCE EXTENSIVE FAUNA

ONE of the most superb animals of our North American fauna, the bison, at one time ranging in impressive numbers over about a third of the continent of North America, is today little more than a tradition. The tardy protection accorded this noble animal in such wild life sanctuaries as the Yellowstone National Park, the Montana National Bison Range, and the Wachita National Game Reserve, and the praiseworthy efforts made by such organizations as the American Bison Society in establishing nucleus herds in different parts of the country, have saved the bison from complete extinction. Every one is familiar with the imprint of the bison on our five-cent pieces; but as a live creature, whether behind the bars of a menagerie or enjoying a restricted freedom on one of the reserves, the bison is all too rare. So far as the United States is concerned, there are no more wild herds.

More fortunate in this respect is Canada, for in that area of Alberta and Northwest Territories that is bounded on the north by Great Slave Lake, on the west by the Buffalo River and the Caribou Mountains, on the southeast by the Peace River, and on the east by the Slave River, there still roams in its wild state a remnant of the millions that once shared the untilled stretches of North America with the Indian and the prairie wolf. This remnant is interesting not only as a survival of a once numerous fauna but also because through its isolation and the conditions of its environment, it has, according to certain zoölogists, undergone specialization, being recognized by them today as a distinct race or subspecies, *Bison bison athabascæ* Rhoads.

So apt is one to think of the bison as a denizen of the plains that a shock of surprise is experienced when one is told that the subspecies just mentioned ranges through forested country and that its popular name is "wood bison." NATURAL HISTORY is privileged to reproduce several pictures taken by Mr. F. H. Kitto and supplied through the courtesy of Mr. James White, Deputy Head, Commission of Conservation, Ottawa, Canada, that are devoted to this interesting animal, and



RANGE OF WOOD BISON

Limits of range

The wood bison of Canada, the only wild herd of these ruminants that is today extant in North America, occupies a forested area about 4,000 square miles in extent. The northern limit of this area almost attains Great Slave Lake; the southern limit just falls short of the northward bend of the Peace River before its confluence with the Slave. These bison are divided into two bands, which, in recent years at least, have not intermingled. The one band ranges over the southern half of the expanse indicated by the boot-shaped figure on the map. The other, of which much less is known, is confined to the northern half of the demarcated area. In its migrations over its range the southern band follows apparently the same route year after year. In early summer it is found in small groups in the northern part of its range. In August the band begins to move southward, to remain for the winter not far north of Peace River. For a full account of the wood bison and the country over which it ranges the reader is referred to the volume by C. Gordon Hewitt, entitled *The Conservation of the Wild Life of Canada*, recently published by Charles Scribner's Sons, to which firm Natural History is indebted for the reproduction of this map

to furnish information regarding it gleaned from the section on the wood bison in the volume entitled *The Conservation of the Wild Life of Canada* by the late C. Gordon Hewitt, Consulting Zoölogist of the Canadian Government. This volume, recently published by Charles Scribner's Sons, may be warmly recommended to all those interested in the larger wild mammals and the birds and in their protection from the dangers to which they are exposed as a result of the expanding population and the penetration of nature's fastnesses.

It is said that the wood bison is differentiated from its fellows by greater size, darker color, denser and silkier hair, and by the possession of horns that are larger and more incurved. Within the geographical area above indicated there are two separate bands, occupying two distinct ranges, there being no evidence that, in recent years at least, migrations have occurred from one range to the other. A belt of muskeg country from thirty to forty miles in width, which prevents migration except by way of the Salt Plain, separates the southern range, covering an area of about two thousand square miles from the northern range, the area of which is as large as that of the southern, if not larger. It has been estimated that the northern band comprises about one thousand individuals, but, as its territory has not, so far as known, been traversed by any white man, the estimate arrived at must be regarded as arbitrary. It is possible that in the southern range the bison approximate one thousand head, though earlier estimates have been less generous.

What little is known of the northern range would seem to indicate that in tree growth, soil, and topography it resembles the country occupied by the southern band. This southern range is described as "a flat or gently undulating plain, lying at an elevation of about 800 feet above sea-level." The only irregularities in its surface are ridges of sand or bowlders of limestone, which at most rise to the modest height of one hundred feet, and sink holes of great size with which it is frequently pitted. Lakes and streams are few and the water of several of the former is too alkaline to be drinkable.

The entire range is more or less timbered, but interspersed there are open patches of prairie, covering as a rule only a few hundred yards but sometimes, for instance on the northern range and in the valley of the Salt River, occupying an expanse of several square miles. In addition to various growths of nutritive value, there has been found in the area larkspur, *Delphinium glaucum*, which is poisonous to domestic cattle. The tree most prevalent is the white poplar, but on the sandy ridges grow jack-pines and, where there is the requisite moisture, spruce trees are found.

Mr. Charles Camsell, now Deputy Minister, Department of Mines, in the Dominion Government, who at Mr. Hewitt's suggestion made observations of and gathered information regarding the wood bison during a trip undertaken to that region of the Canadian Northwest, reported, as a result of his gleanings from various sources, that the southern band, during the early summer, browses in the northern part of its range, near the Little Buffalo River. During the greater part of the year the animals are divided into small groups of ten or a dozen individuals but in July and August, which are the months when mating occurs, the bison assemble in herds of twenty, thirty, or forty, one Indian even asserting that he had at one time seen a herd consisting of nearly one hundred head. In August the bison of the southern band start southward to sojourn for the winter not far north of the Peace River, between Peace Point and Point Providence. In migrating they seem to follow the same route year after year. Numerous deep trails through the woods, similar to the well-known trails made by the bison of the plains in their travels, mark the route they annually traverse. On the sides of hills and in the patches of prairie along the line of march, wallows are of frequent occurrence. Of particular interest was a salt lick observed by Mr. Camsell, which was scarred and covered over an expanse of five or six acres by the tracks of bison of all ages, including

Courtesy of the Department of the Interior, Canada

A vista through the forest affording a distant glimpse of two wild bison

Copyrighted by the Department of the Interior, Canada

Although during a greater part of the year the bison are found in groups of ten or twelve individuals, and in the mating season in even larger assemblages, solitary wanderers are also encountered yearlings and calves. A single bison bull seen by Mr. Camsell on this site was so fearless that the observer was able to approach within fifty feet of him.

It is the conclusion of Mr. Camsell that the wood bison is not only holding its own but is actually on the increase. The Northwest Game Act, passed by the Dominion Parliament in 1906, establishing a close season for bison, has doubtless been partly responsible for the growth in numbers, notwithstanding the fact that poaching was referred to as a greater danger than the wolves by Inspector A. M. Jarvis, of the Royal North West Mounted Police, who in 1907 was sent from Regina to the Athabaska region for the express purpose of ascertaining the number of wood bison then existing and their condition, and of making recommendations for their more adequate protection. One of the several recommendations made by Inspector Jarvis was to convert the entire area into a national park. This recommendation is renewed by Mr. Hewitt, who points out that "if a portion of their range could be made a national park, there is no reason why the wood bison should not only be saved from extermination, but there is every reason to believe that the surplus would migrate into the adjacent territory, which is unsuited to agriculture and therefore could be justifiably devoted to the preservation of the only examples of our largest and noblest native mammal now living in its original wild state."

Surely the expanding population of North America, which in so brief a span of years has driven the remnants of the once abundant wild life of the continent into remote and forbidding fastnesses for sanctuary, will not begrudge the dedication of this strip of uninviting territory as the inviolate habitat for all time of an animal once ranging all the way from Great Slave Lake to northern Mexico and in its utmost southeastward extension reaching even the state of Georgia. In their heyday these ruminants constituted a vast herd. Dr. William T. Hornaday says that "it would have been as easy to count or to estimate the number of leaves in a forest as to calculate the number of buffaloes living at any given time during the history of the species previous to 1870."

In 1869 the Union Pacific Railroad was opened, in 1870 the Kansas Pacific Railway followed suit, and not long after, the Atchison, Topeka, and Santa Fé stretched its steel rails across the lands of the bison and made easy the approach of the hunter. An orgy of destruction followed over which one willingly draws the veil. Today the opportunity is given to save the scattered survivors of this fine animal and among these, few would seem to offer more points of interest than the wood bison of Canada.

The Gothic building, or wing, of the Hungarian Agricultural Museum is popularly called "the castle of Vajada-Hunyad," because the façade on the water front is a faithful reproduction of a famous Transylvanian building of that name. The collections in this building are those of forestry, fish, and game

THE AGRICULTURAL MUSEUM

AN EDUCATIONAL MEDIUM THAT EUROPE HAS AND AMERICA NEEDS

BY

FREDERIC A. LUCAS*

AT THE meeting of the American Association of Museums on Nov. 30, 1921, Mr. F. Lamson-Scribner pointed out that there was a strange lack of museums devoted to the exposition of agriculture and that nowhere was this lack more striking than in the United States. Here, as Mr. Lamson-Scribner indicated, we are rather worse off than we were fifty years ago. We have not even stood still but have gone backward, for a half century ago there was a fairly complete museum in the Department of Agriculture and now there is only a small collection consisting of exhibits that have been shown at the various expositions. It is painful to admit that they have done vastly better abroad than we have here in respect to education in agriculture by means of museums. By the courtesy of Mr. Lamson-Scribner the writer is able to show some of the beautiful edifices that have been erected for this purpose. Mr. Lamson-Scribner specified some of the subjects that could be illustrated by exhibits that would not only be instructive but at the same time attractive, a most important point, since to interest the average visitor in a subject it must be presented in an attractive manner.

Mr. Lamson-Scribner states that

*Director of the American Museum of Natural History

In the hall of the Hungarian Agricultural Museum that is devoted to rural architecture are models of all kinds of farm buildings; owners' dwellings, servants' houses, stables, granaries, and general farm equipment

To the left of the royal hall one may enter the section devoted to the collections illustrating various breeds of horses, including finely carved models of famous thoroughbreds. On the walls are illustrations in oil and many photographs and charts. In this room is a statue of Frances Kozna, renowned as a horsebreeder "whatever the reason may be, the fact remains that agriculture offers a field for museum activity unsurpassed by any other subject. It includes almost every line of human endeavor; touches the lives of all peoples and draws upon almost every department of science and art in the exercise of its functions. Certainly there is abundant material for such a museum. . . .

"The establishment of an educational museum devoted strictly to agriculture opens practically a new and untried field in museum-making in this country. The functions of such a museum are not only to gather and preserve collections that shall interest and instruct, but also to make agriculture attractive as a profession. It must not only encourage but also lead in those measures that shall secure to our agrarian communities their full share of happiness and contentment. . . . The time has arrived when the subject should be given the fullest consideration. A sentiment favorable to museums of all kinds is rapidly developing and the demands of the public are becoming more and more insistent for methods of visual instruction and entertainment so that 'he who runs may read' and enjoy.

"Our agricultural museum is neither commonplace nor lacking in elements of science, while its collections are filled with potentialities eloquent with beauty. In our visions it ranks with the greatest and most exalted endeavors designed to educate the people and advance the standards of civilization. Its advent will mark the fulfilment of long cherished dreams and the achievement of ideals where science and art shall chant in unison the songs of Ceres to all mankind in a great American Museum of Agriculture."

All the first, or ground, floor of the Gothic building of the Hungarian Agricultural Museum is devoted to forestry. Here are collections illustrating nearly every phase of the subject—scientific, industrial, and commercial—pertinent to Hungary. The collections include specimens of insects and other pests injurious to forest trees

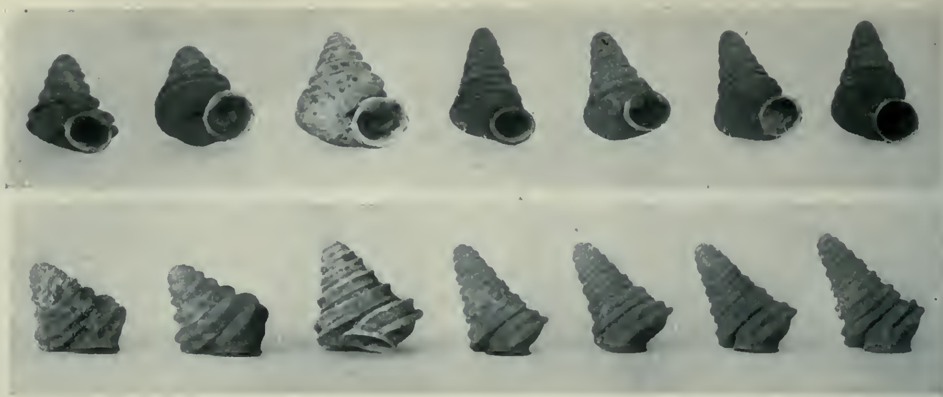
On Invalidenstrasse, in Berlin, is situated the great agricultural museum of Germany. The collections occupy the first two floors of the building, which is 283 feet long by 216 feet deep. The third, or top, floor contains the library and the class and work rooms of the Agricultural High School

Associated with this building is one of like design devoted to geology, while a larger, central building in the group contains general natural history collections

The agricultural museum of the Rural Society of Argentina is located at the corner of Avenida Sarmiento and Calle Santa Fe. It is 300 feet long by 85 feet wide and was completed in 1910 at a cost of about $100,000. The interior is like one immense, well-lighted hall with a broad balcony extending entirely around it, thus greatly enlarging the exhibit area

The designs for the United States Department of Agriculture building, which was completed in 1868, included a hall on the second floor to be devoted to a museum. This hall was 50 x 100 feet with a lofty ceiling, and was lighted on both sides by five high, arched windows. For nearly twenty years the collections of the Department occupied this hall, at one time filling forty large cases. The demands for space by other activities finally forced these collections from the building

In 1887 the collections of the Agricultural Department which had not already been transferred to the National Museum were removed to a wooden building, then located in the southeastern section of the department grounds. This building was constructed to house a quantity of museum material acquired from the exposition held in Atlanta, Georgia, in 1881.



A series of *Cclithephila turricula*, about twice the natural size, showing the range of variation

PORTO SANTO AND ITS SNAILS

BY

T. D. A. COCKERELL*

THE small island of Porto Santo is one of the Madeira group, out in the broad Atlantic about four hundred miles due west of Saffi, Morocco. It is only about six and one half miles long, and three miles across where it broadens at the eastern end. The highest elevation (Pico do Facho) is 1660 feet above sea level. Porto Santo is interesting for many reasons. Here Christopher Columbus lived and, looking across the ocean, wondered what might be beyond. The small town, Villa Baleira, still retains much of its primitive simplicity, and the fishermen go out to spear the tuna as they must have done in the days of Columbus.

To the naturalist this island, at first sight barren and unpromising, is one of the most fascinating places on the globe. Here are to be found many species of land shells which occur nowhere else and which are evidently the relics of an ancient fauna. Their apparent relatives occur in the Tertiary rocks of France and Germany, but they have become extinct in Europe. Just as the giant tortoises survived on the Galápagos Islands, while becoming extinct in North America, so certain types of snails seem to have held out to the present day in the Madeira Islands, though failing to survive on the adjacent continents. This persistence of general type has been accompanied, however, by a surprising amount of specific diversification or evolution, with the result that the islands contain a large number of very distinct forms, often very local in their distribution. Thus the naturalist has before him at the same time relics of the remote past and evidences of comparatively recent changes, all combined in the same individual snails. For an intensive study of the problem of species it would be difficult to find a more favorable spot.

Soundings show that the present island of Porto Santo stands on a large submarine elevation which was probably above water in former times. Around the edges of this elevation or bank the depth suddenly increases, so that at one point we get from 30 to 50 fathoms, and a very short distance beyond as much as 200 or more. This indicates great submarine cliffs, which presumably must have been formed under aërial conditions. This bank extends mainly north and south, and does not go far in the direction of the main island of Madeira.

*Professor of Zoölogy, University of Colorado

The upper picture represents the southeast corner of Porto Santo, with the Ilhéo de Cima rising from the sea in the middle background. On this island—and nowhere else in the world—is found *Ochthephila turricula*.

The bay on the southern shore of Porto Santo is shown in the lower picture. The town of Villa Baleira in the distance is faintly visible. Beyond rises Anna Ferreira Peak to a height of 277 meters. The long island on the horizon is the Ilhéo de Baixo. This island is the only place where the remarkable *Helix subplicata* of Sowerby (type of a new genus or subgenus *Idiomela*, described elsewhere) survives. It is found in fossil form on the north side of Porto Santo

Although the eastern end of Madeira is in plain sight from Porto Santo, there is a depth of 1170 fathoms between the islands.

The submerged area, in the immediate vicinity of Porto Santo, still exhibits a number of minor elevations, which form small islands or islets. The largest of these is the Ilhéo de Baixo, or lower island, to the southwest. It is nearly 2700 meters long, with a flat top, on which is very scanty vegetation. This small island produces lime, which is exported to Madeira, to be used in building. The next largest islet, about 1200 meters long, is at the opposite end of the bay, and is called the Ilhéo de Cima, or upper island. Here is situated the lighthouse, which is sighted by passing ships on nearing the Madeiras. There are several other islets, some of them mere rocks.

Living *Ochthephila turricula*. One of them was coaxed out of its shell by being placed on a lettuce leaf

All of these islets, if large enough to support a little vegetation and a snail fauna, have their peculiar species or races of snails. On the Ilhéo de Cima we find swarming under rocks the extremely remarkable and distinct *Ochthephila turricula* of Lowe.[1] It seems extraordinary to stand on Cima, holding a handful of these snails just picked from beneath the volcanic rocks, and look across to Porto Santo and Baixo, realizing that these near-by shores, with similar environmental conditions, entirely lack the species. Nowhere else in the world may *Ochthephila turricula* be found. The channel between Cima and Porto Santo is not quite 300 meters wide, and there are rocks in it toward the Porto Santo side.

The Madeira Islands, including Porto Santo, are volcanic. Everywhere we see evidences of violent eruptions and flows of lava. We get the impression of great disturbances, many doubtless of a catastrophic character. But our little *Ochthephila turricula* tells us that this was long ago. For a considerable period, during the lifetime of this species, there must have been great stability. A little elevation would connect Cima with the main island of Porto Santo, permitting *Ochthephila turricula* to cross. A little depression (Cima is about 110 meters high) would sink it beneath the waves, exterminating the turreted snails. Thus the study of snails may tell us something about the geological history of the islands.

Students of heredity have pointed out that a mixed population, isolated and left to itself, tends to become uniform in its characters, even if originally variable. It is a singular thing that this does not apply to several of the snails on the islets off Porto Santo. *Ochthephila turricula*, in particular, shows a considerable range of variation, in spite of being confined to such a small area, where the physical conditions vary little.

My wife and I visited the most remote of the islets, called Nordeste. It is a mere rock, no larger than a big building, yet it has two kinds of snails peculiar to it, and we also discovered a beetle found nowhere else. Four strong Portuguese sailors took us out in a fishing boat, and as we reached the rough volcanic shore, one of them sprang to a barnacle-covered rock and held out his hand for us. It seemed a little hazardous to jump from the boat, rising and falling on the waves, but with the aid of our good sailors we easily made the landing, and were soon rewarded by the discovery of specimens of the elegant *Leptaxis forensis*, dark colored with a pink apex, and the button-like *Ochthephila gomesiana*, the two kinds of snails peculiar to this rock. On Nordeste we also found a new beetle, which was named *Helops lucifugus maritimus*, new subspecies. On the way home I landed for a short time on Cenouras Island, which had never been explored for snails. I was rewarded by a new species, since described as *Ochthephila cenourensis*.

[1]These snails belong to a genus called *Geomitra* in recent works. The older name, *Ochthephila* of Beck, was suppressed because it was believed to have been used earlier by Fallén for a fly. It turns out, however, that the fly was called *Ochtiphila*.

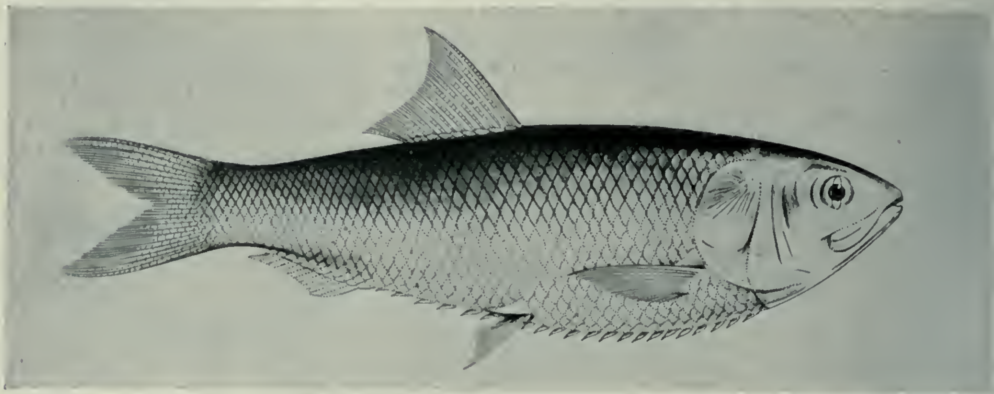
RESTORATIONS FIGURING MIOCENE FISHES

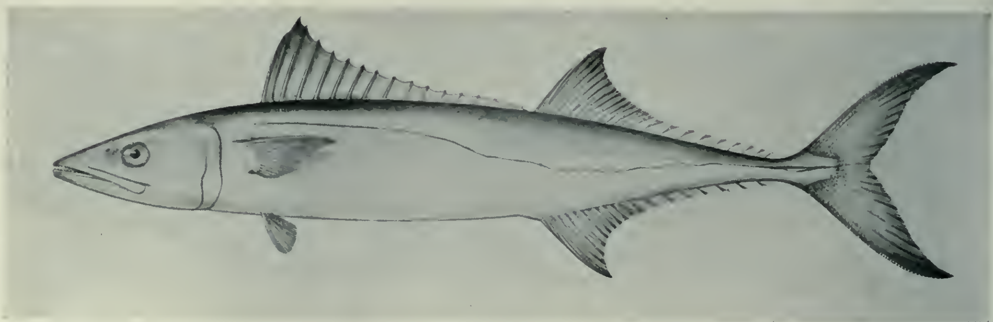
Fishes which occurred in California during the Miocene are of especial interest as representing the immediate ancestors of marine fishes of the present day. These illustrations are reconstructions[1] of species found as fossils at Lompoc, California. They were furnished to NATURAL HISTORY by Dr. David Starr Jordan, under whose direction they were prepared by Mr. W. S. Atkinson, and are selected from a larger number to illustrate how like are some of the familiar species of the present to the fish life of that time.

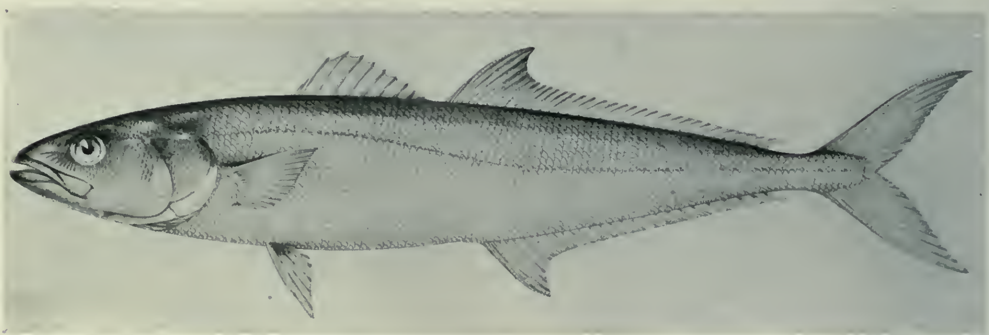
Modern representatives of *Zororhombus veliger*, Jordan, are the turbot and the brill, important European food fishes

[1] The Miocene fishes figured are with one exception placed in genera different from, though closely related to, those now living. The exception is *Hexagrammos achrestus*, and here the details of head, scales, and tail are taken from living species of *Hexagrammos*.

The reconstruction of extinct animals is never entirely satisfactory as to details. According to Dr. Jordan, in *Xyne grex* the number of scales is uncertain, and the body, drawn from the largest example, may be too deep and the scutes relatively too large. Some details of head and scales are uncertain in *Emmachaere rhomalea*. Size of mouth and some other details are not quite certain in *Lompoquia retropes*. *Rhythmias starrii* may or may not have had an antrorse dorsal spine, and some minor details are uncertain. The head of *Lompochites hopkinsi* is uncertain in some details, as also the number of its scales, and it may have had a finlet after the dorsal and anal fins. In *Ocystias sagitta* the head is uncertain, and some details of fins perhaps questionable. In *Sebastinus ineziæ* the armature of head is uncertain; back should perhaps be less arched, the mouth larger. There are no uncertainties of importance in *Zororhombus veliger*.







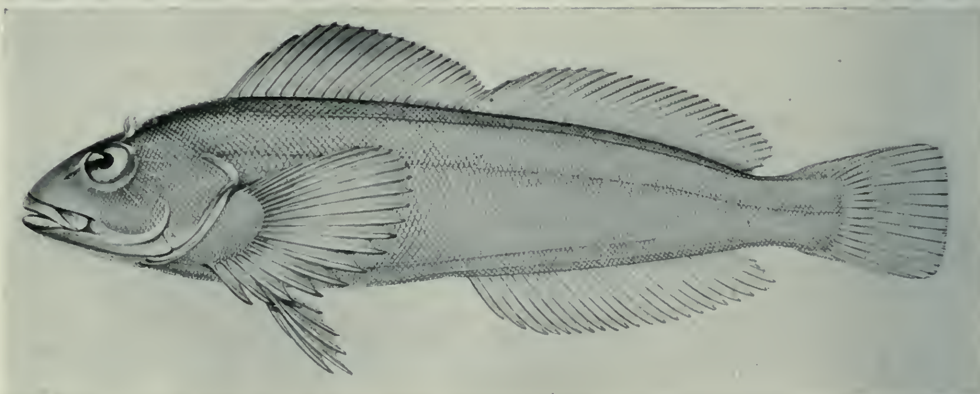
Uppermost picture.—*Xyne grex*, Jordan and J. Z. Gilbert, is superficially very like present-day herrings

Middle picture.—*Ocystias sagitta*, Jordan, is related to a group of mackerel of world-wide distribution in warm seas, among which are the delicious Spanish mackerel and the big, silver, Florida kingfish, sought by off-shore sporting anglers

Picture at the bottom.—The closest extant relative of *Lompochites hopkinsi*, Jordan, which belongs to the pompano family, is uncertain, but this extinct swimmer is suggestive of *Elagatis*, a large, swift, beautiful, off-shore fish, standing apart from the rest of the family, nearest to the amberjacks

Upper picture.—The nearest living relative of *Emmachære rhomalea*, Jordan, one of the thriving family of sea basses, is perhaps the giant *Stereolepis gigas*, which lurks in the waters off the California coast

Lower picture.—To the porgy family, several small species of which are food fishes of our Atlantic coast, belongs *Rhythmias s'arrii*, Jordan and Gilbert. Among present-day fishes perhaps *Salema pourtalesi* in the Galápagos Islands is the one most closely related to it



Uppermost picture.—The weakfishes, important food fishes on sandy shores of both coasts of America, are the nearest living relatives of the extinct *Lompoquia retropes*, Jordan and Gilbert

Middle picture.—An early development of the sculpin tribe, now widely distributed in the waters of the north, is the rockfish, *Hexagrammos*, here represented by *H. achrestus*, Jordan and Gilbert. Several species of this genus still occur on the Pacific coast

Picture at bottom.—*Sebastinus ineziæ*, Jordan and Gilbert, is close to the rock cods of the North Pacific, which are primitive members of the sculpin tribe

NOTES

HENRY POMEROY DAVISON

A SPECIAL meeting of the Board of Trustees of the American Museum was held on May 17, 1922, to frame a Resolution recognizing the invaluable services to the Museum of Mr. Henry Pomeroy Davison and to select his successor in the office of treasurer. President Henry Fairfield Osborn opened the meeting with the following tribute to Mr. Davison:

"We have lost one of the best men of our times, just at the moment when he was most needed for the world's reconstruction. He had won a rare position in America, England, and France. Both in finance and in philanthropy his simple, straightforward, genial, and confident spirit helped to carry our country through the great crisis, and his warm sympathy for the brave men and women of the Allies made his selection by President Wilson as head of the Red Cross an ideal one.

"Millions of the men and women he helped have thought of him in the long and hard struggle he had made for his own life during the last two years and will grieve over the sad ending. Our only consolation now is in the belief that such a death is a victory and that the life of such a patriot will give new courage and fortitude to those who are striving to maintain the high and unselfish standard of true Americanism."

The following resolution was then offered and adopted by a rising vote:

"*Resolved:* That the Trustees desire to record their deep sense of loss through death on May 6, 1922, of

HENRY POMEROY DAVISON

Mr. Davison was elected to the Board on February 7, 1916, and served as Treasurer and as Chairman of the Finance Committee until his decease. With the numerous demands upon his time and energy by world affairs in finance and in the welfare of humanity, Mr. Davison maintained a continuous interest in the Museum's activities and through his wise counsel and clear grasp of public problems rendered the Museum an incalculable service. At his suggestion, soon after taking office, the Board appointed an Advisory Committee on Investments, composed of financial experts of the highest character, who have given close attention to the Museum's invested funds and have steadily improved the stability of the Museum's holdings. Thus, indirectly, Mr. Davison has made a permanent contribution to the security of the Museum's basic finances.

"His presence on our Board will be missed, not alone for his practical service but because of his genial and lovable nature.

"*Resolved:* That the minutes of this meeting be suitably engrossed and a copy sent to the members of Mr. Davison's family."

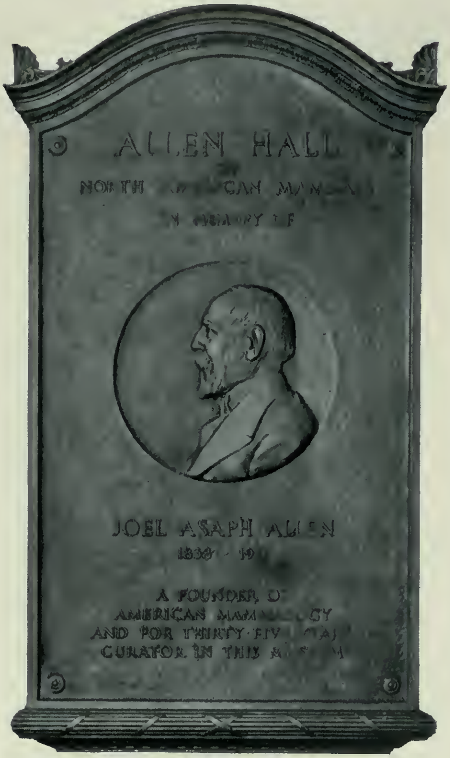
MAMMALS

ALLEN HALL AND MEMORIAL TABLET.—On the morning of May 18 there was unveiled on the second floor of the American Museum, in the hall that will henceforth perpetuate the name of Dr. Joel Asaph Allen, a bronze tablet in honor of that scientist. President Henry Fairfield Osborn, who presided, addressed an audience which included not only members of Dr. Allen's family and the scientific staff of the Museum, but representatives of the American Society of Mammalogists, of which society Dr. Allen was the only Honorary Member. President Osborn recounted the steps taken to establish the memorial to Dr. Allen and then, on behalf of the trustees of the Museum, presented the tablet and announced that henceforth the hall of mammals would be known as Allen Hall. He referred to Dr. Allen as "our exemplar in this Museum for many years just as he was the exemplar of the young naturalists of America."

President Osborn then asked Director F. A. Lucas to unveil the tablet. As the veil was drawn aside, there was revealed a handsome plaque of bronze, the upper and lower surfaces of which were occupied by inscriptions, the central area by a medallion portrait in bas relief of Dr. Allen, sculptured by T. Spicer Simson.

Dr. Frank M. Chapman, the next speaker, alluded to the modesty of Dr. Allen, to his feeling of surprise when honors were conferred upon him—honors which, retiring student that he was, were never of his seeking—and ventured the opinion that he would have viewed in the same spirit of self-effacement the signal honor paid him in the unveiling of the tablet and the naming of the hall. On behalf of the scientific staff of the Museum, of the division of zoölogy and zoögeography, representing the activities with which Dr. Allen was most closely associated, and of American science in general, Dr. Chapman thanked President Osborn and the trustees for this tribute to his departed associate and friend.

The closing address was delivered by Dr. E. W. Nelson, chief of the Bureau of Biological Survey, who had known Dr. Allen for forty-five years and who numbered Dr. Allen's kindly encouragement among the factors that had prompted him to follow a scientific career. Dr. Nelson pictured the difficulties that beset the young naturalist when Dr. Allen began his studies—the dearth of facilities and the unsympathetic attitude of the public—and pointed out that "under such handicaps persistence in making natural science a life work meant the devotion of an enthusiast." Dr. Nelson then sketched in brief the career of Dr. Allen: his field experiences, the part he played in organizing



Memorial tablet to Dr. Joel Asaph Allen, unveiled at the American Museum on May 18. The central area is occupied by a medallion portrait of Dr. Allen, sculptured by T. Spicer Simson

the Nuttall Ornithological Club and its successor, the American Ornithologists' Union, as well as the National Association of Audubon Societies, his part in the formulation of the American Ornithologists' Union model bird law and its code of zoölogical nomenclature, his work at the Museum of Comparative Zoölogy, then known as the Agassiz Museum, his accomplishment in developing the study collections of the American Museum, where he became curator of birds and mammals in 1885, his editorship of the *Nuttall Bulletin*, *The Auk*, and the publications of the American Museum, and finally, his contributions to scientific literature, represented by "a bibliography almost unequaled in length by that of any other scientist." In closing, Dr. Nelson said:

"For many years Doctor Allen's career served as a great stimulus to young naturalists throughout the country. His clearness of insight and mental powers were backed with a strong will, which quickly impressed all who came in close contact with him. Among American scientific men few have been held in such general esteem and have been able so to influence their contemporaries and the development of the sciences in which they worked. His loss will long be felt not only among those who had the privilege of knowing him personally but by many workers who paid him the tribute of admiration and respect as a great scientific leader."

GEORGE FISHER BAKER, JR.

The New Treasurer of the American Museum.—At a special meeting of the Board of Trustees, held on May 17, George Fisher Baker, Jr. was unanimously elected treasurer of the American Museum. The new treasurer has already justified the faith his fellow trustees reposed in him by the capable and energetic way in which he has entered upon his new duties. Although it is little more than a month since he assumed the custodianship of the funds of this institution, it is abundantly evident that Mr. Baker is a worthy successor in office to Mr. Davison, and that his good judgment and practical wisdom, coupled with his devotion to his work, will be of increasing value to the Museum.

THE THIRD ASIATIC EXPEDITION

An Important Discovery.—It was on April 16 that the American Museum received the following cable from Mr. Roy Chapman Andrews, the leader of the Third Asiatic Expedition, which the Museum is conducting in coöperation with the American Asiatic Society and *Asia:* "Everything fine goodbye." The message announced the departure of the expedition for Mongolia, where in the period before October 1, the ultimate date for effective work in that region, it is planned to make a reconnaissance of the zoölogy, geology, palæontology, and geography of the part of the country traversed.

Already results of great significance are foreshadowed, for a second cable received by President Henry Fairfield Osborn from Mr. Andrews contains the news: "Expedition immediately discovered important Cretaceous and Tertiary beds with fragmentary fossils of mammals and dinosaurs." The importance of this announcement cannot be overestimated. The region where these discoveries were made is part of the Desert of Gobi. Little or nothing has been known of the geological history of this remote region of Central Asia.

In 1907 Bailey Willis, one of the chief authorities on Chinese geology, wrote in his *Research in China*, Vol. II, p. 95, "Nor are Cretaceous strata of any kind known in the vast area of Asia north of Thibet, east of the Urals and south of northern Siberia." On the following page Willis says, "A sedimentary record of the Tertiary history of China is wanting, as is that of the Cretaceous." No dinosaurs have ever been found anywhere in central Asia, and very little has been known as to the fossil mammals of this vast region.

The country to the west and south of Urga that is being traversed by the expedition is commonly called a desert, but it is really a region of rolling plains and foothills leading up to snow-covered mountains. It is not unlike in character to our western plains, once known as the "Great American Desert." The discovery of fossils in such a region is not surprising, for it is in just such areas that most of the extinct animals of the western states have been found.

Magnitude of the Collections.—The results attained thus far by the Third Asiatic Expedition exceed the most sanguine expectations. Working in a land where native superstition is an obstacle to scientific investigation and where the political uncertainties make travel hazardous and collecting difficult, the expedition has gone ahead tactfully, methodically, courageously, gathering for permanent record the extinct and the recent animals of China. In a letter dated March 2, 1922, Mr. Roy Chapman Andrews, the leader of the expedition, summarized the results of the collecting from August to March. It has yielded "more than 1300 mammals—many of them large—300 birds, 10,000 fish, reptiles, and batrachians, and 33 cases of fossils. . . . In the mammals, we shall far exceed, at this rate, the 10,000 specimens which I had estimated would be obtained by this expedition alone." The staff of the expedition at the time of writing consisted, native and foreign, of 35 men, 8 of them scientists.

A Natural History Museum for Peking.—Although the widening of our knowledge of the fauna, living and extinct, of Asia and the enrichment of the collections of the American Museum are the major purposes of the Third Asiatic Expedition and are absorbing its best energies, it has not failed to recognize its opportunity and its duty of encouraging scientific activities in the country where its field work is being pursued. It has had closely at heart a project, warmly sponsored by President Henry Fairfield Osborn, of establishing in Peking a museum of natural history. To this end the President of China, a man of scholarly attainments and greatly interested in all educational proposals, granted Mr. Roy Chapman Andrews an interview lasting nearly an hour, at the conclusion of which he promised to discuss the matter at a cabinet meeting and see what steps could be taken to formulate a plan which would have a practical working basis. A copy of a dispatch from the American Legation at Peking was transmitted to President Osborn by the Department of State and gives the official report of the interview in question. It reads:

Legation of the
United States of America
Peking.
March 10th, 1922.

No. 442.
The Honorable,
The Secretary of State,
Washington.

Sir:

I have the honor to state that Mr. Roy Chapman Andrews, Leader of the Third Asiatic Expedition, sent out by the American Museum of Natural History of New York, requested the Legation to make arrangements for him to present in person to the President of China a special collection of photographs of the exhibits in that Museum. It was Mr. Andrews' desire at the same time to sound the President in regard to a tentative proposal for the creation of a Museum of natural history in Peking, the said Museum to be provided by his own institution with a duplicate set of specimens collected.

The interview requested has today taken place, Mr. Andrews being introduced by the Chinese Secretary of the Legation. The President appeared enthusiastic about the proposed Museum in Peking and readily assented to the possibilities of devoting one of the buildings in the Forbidden City to this purpose. In response to Mr. Andrews' thanks for the numerous courtesies extended by the Chinese Government to the representatives of the American Museum of Natural History, the President replied that his Government was most happy to assist in the work of education now carried on by the Museum.

I have the honor to be, Sir,
Your obedient servant,
(For the Minister)
A. B. Ruddock.

REPTILES

Expedition of the University of California.—Mr. C. L. Camp, who has been pursuing research work in the department of herpetology, American Museum, has become research associate (department of geology) of the Museum of Vertebrate Zoölogy of the University of California, where he will devote his major attention to the morphology of the ancient reptiles, especially the ichthyosaurs and other marine reptiles. He will also lecture on the evolution of the vertebrates. During the summer Mr. Camp will be a member of an expedition sent out by the department of geology of the University of California. The expedition will probably be located near Adamana, Arizona, working over the Triassic beds of that region.

BIRDS

The Expedition to Ecuador.—On June 20, Dr. Frank M. Chapman, curator of the department of birds in the American Museum, will sail for Ecuador, accompanied by Mr. George K. Cherrie and Mr. Geoffrey N. O'Connell. Dr. Chapman's purpose in organizing this expedition is to continue the biological survey of the Andean region by a personal examination of its topography and a study of its climatic conditions —indispensable preliminaries to a correct interpretation of the collections that he is making from that area of the world. Locality records mean little, particularly in a mountainous country where a steep ascent some distance above a named place on the map may have a fauna different from that characterizing the region below. Nor is altitude the only factor to be considered, for a particular life zone will under favoring conditions invade, in patches or broadly, the area normally occupied by another zone. Unless, therefore, the trained scientist is on hand to study the country, to note the precise spot where a bird is taken, and the conditions of its environment, misleading conclusions will be drawn almost inevitably.

The expedition will be located first at Guayaquil, working over the lowland area that stretches beyond this city, once the pest-house of South America, but now, thanks to the sanitary work accomplished there by the Rockefeller Foundation, a spot of comparatively safe sojourn (see NATURAL HISTORY for May-June, 1921, pp. 279–281). Later the expedition will move on to Quito, more than 9300 feet above sea level, which will serve as a base for the study of the avifauna of the uplands.

It is less than a year since Mr. Cherrie through one of those rare examples of fortitude and self-mastery that rise resplendently above the humdrum level of human behavior walked, though severely wounded and suffering intense pain, a distance of eighty-five miles from the interior to the coast, climbing and descending in the course of this ordeal a mountain 8000 feet in height. Many at that time, learning of the severe character of his wound, questioned whether he would ever be able to take the field again. The fact that he is accompanying Dr. Chapman to Ecuador gives the assuring answer. Mr. O'Connell, the third member of the expedition, accompanied Dr. Chapman to Colombia in 1913 and is, therefore, conversant with the problems to which the present expedition will devote its attention.

THE WHITNEY SOUTH SEA EXPEDITION.—No longer dependent on the uncertain sailings of local vessels, the members of the expedition are plying from island to island in the newly acquired schooner, the "France." Places off the beaten track have been visited, with the result that among the recent shipments of specimens sent to the American Museum are at least two new species of birds in addition to many known ones. Photographs in great number have been taken in these remote parts and afford interesting glimpses of the life of the Polynesians.

The most recent letter from Mr. Rollo H. Beck, the leader of the expedition, is dated March 13 and was written at Pitcairn Island, one of the most out-of-the-way spots on the globe. In this letter Mr. Beck reported regarding his collecting at Rapa Island (to which another visit was paid subsequent to that described in the January-February issue of NATURAL HISTORY, pp. 70–81), at Bass Rocks, and at Ravaivai, one of the Austral Islands. He states that his next objective is Ducie, three hundred miles to the east, and closes his letter with a request for labels as the speed with which the collecting is proceeding is exhausting the supply that he has with him.

NEW YORK ZOÖLOGICAL SOCIETY

THE MUSEUM OF THE NATIONAL COLLECTION OF HEADS AND HORNS.—On May 25 the Museum of the National Collection of Heads and Horns, erected by the New York Zoölogical Society, was dedicated and opened to the public. To the untiring efforts of Dr. William T. Hornaday, who in association with Mr. Madison Grant originated the undertaking in 1906, is due in no small measure the credit for having brought together this splendid array of heads, but without the generous aid of many individuals, who contributed either whole collections or miscellaneous specimens, the goal toward which he has been striving for so many years could not have been reached. As for the Museum building, Dr. Hornaday says its acquisition was due "largely to the initiatory foresight, energy and good will of Mrs. Frederick Ferris Thompson." Other generous contributors were Mrs. Russell Sage, John D. Archbold, Jacob H. Schiff, George F. Baker, Mrs. Andrew Carnegie, Andrew Carnegie, Edmund C. Converse, Samuel Thorne (In Memoriam), and George D. Pratt.

Two exhibition halls, composing the main floor, are now open to the public. In the one the specimens are with few exceptions arranged zoölogically, by families and genera; in the other, the arrangement is geographic. In the second of these halls find place also the "Combat Collection," showing animals whose antlers have become interlocked in head to head encounter, and the "Collection to Illustrate Horn Development and Anatomy." It will be possible for 60,000 visitors to pass through these halls daily, seeing all the specimens exhibited and without the inconvenience of jostling against individuals headed in an opposing direction. A third hall, on the lower story, houses the general collection of duplicates. Access to this hall is for the time being restricted to certain groups interested in the collection for purposes of study.

On the same day that the Museum of the National Collection of Heads and Horns was dedicated, the Annual Garden Party of the New York Zoölogical Society was held, the two events being coupled in the invitations extended jointly by the Board of Managers (Henry Fairfield Osborn, president) and the Ladies Auxiliary (Mrs. Henry Fairfield Osborn, chairman). Dr. Hornaday, introduced by President Osborn to the assembled guests, gave a history of the collection and recounted its aims and purposes. At the conclusion of his remarks, he presented the keys of the new museum to Professor Osborn, who, in turn, presented them to Commissioner of Parks Henessey. At the conclusion of his address Commissioner Henessey unlocked the doors and was followed into the new building by the Board of Managers of the New York Zoölogical Society and the Ladies' Auxiliary.

THE FIRST HOACTZINS IN CAPTIVITY.—There are few birds as interesting as the hoactzins, for a description of which the reader is referred to the article by Mr. Edward M. Brigham, in the issue of NATURAL HISTORY for February, 1919, pp. 163–169. The significant announcement has come from the Tropical Research Station of the New York Zoölogical Society that two adult hoactzins were secured unhurt, that the birds have been at the Station for a week, are feeding well on lettuce and cabbage as well as caladium leaves, are tame, and that "there seems to be no reason why they cannot be shipped North." If this project is carried out and no untoward incident occurs, dwellers in this latitude may have the opportunity of viewing live specimens of these primitive birds, the first to be kept in captivity anywhere. In the young stage the hoactzins present a feature of particular interest, two toes being produced on each wing as aids in climbing. These birds, therefore, literally move about on all fours. A thousand feet of moving-picture film of hoactzins—adults and quadrupedal young—were secured by Mr. John Tee-Van, assistant at the Tropical Research Station, as the result of a five-day trip to Berbice, and constitute an invaluable record of the interesting habits of these birds.

TROPICAL RESEARCH STATION.—In a recent issue of *Zoölogica*, Professor Henry Fairfield Osborn reminds readers that the main object of the Tropical Research Station has from the beginning been, "the observation of living organisms in their natural environment." Tested by this standard the results for April, 1922, submitted by Mr. William Beebe, the director of the Station, are of unusual value and interest, for in addition to the acquisition of the two hoactzins and the moving-picture record of the behavior of these birds in the wild, referred to above, it has been the good fortune of the Station (and good fortune in this case is synonymous with painstaking vigilance on the part of Mr. Beebe and his associates) to discover habits of unusual interest among the living creatures of the environment.

Mr. Beebe refers, for instance, to the finding of a huge frog, which, when alarmed or when seized by a snake, screamed like a stuck pig, a sound so sudden and terrifying as to be a most effective means of defense. A pair of ant birds, which had a nest twenty feet up a tree, would when frightened simulate, partridge-like, a

Hoactzins at the Tropical Research Station of the New York Zoölogical Society—the first to be kept in captivity anywhere broken wing as they moved along the ground, probably a relic of the time when they nested there. The leader of a band of *Cebus* monkeys almost attacked Mr. Beebe, and in his rage broke off all the dead branches within reach, dropping them with a swing of his hand or foot, but not throwing them. This, writes Mr. Beebe, is the nearest approach to the alleged use of a missile by a wild animal that he has ever witnessed. A vampire which attacked two of the members of the Station one night, did not make a round, bored hole as usual, but a distinct longitudinal scrape, clear to the raw flesh, which could not be filled up by the animal's antiseptic saliva, after the ordinary method. This would seem to indicate that there are two species of these bats in the region, or more probably, that the bats have individual methods of attack and operation. A pair of fish (*Geophagus*) were recently seined; each had about fifty young in the mouth. Now and then one or the other of these fish would spew the whole brood into the aquarium water, whereupon the youngsters all righted themselves and rushed back into their parent's mouth. Photographs and moving pictures of this phenomenon were secured.

In a later letter Mr. Beebe records another observation of unusual interest: "An armored catfish was brought in yesterday by an Indian and as usual I tested its powers of walking. To my amazement it proved to be a real quadruped, with four fins functioning the opposite of a horse's legs. The huge spine of the pectorals is the pusher, the tip being stuck into the ground at each sideways wriggle of the fish, the remainder of the fin splaying out as a prop for the front of the body. The rounded palmlike ventrals are wholly props like a horse's front legs, but are actually lifted and pressed down at each step, alternately with the front fins. After thirty feet progression through heavy going, he slows down so that I can get all stages with the moving picture camera. The fish instinctively makes for the bank of the river, even when behind the bungalow at the edge of the jungle."

SCIENTIFIC GATHERINGS

American Society of Mammalogists.—From May 16 to 18 the American Museum served as headquarters for the Fourth Annual Stated Meeting of the American Society of Mammalogists. Except for two business sessions, the ceremonies connected with the unveiling of the memorial tablet to Dr. Joel Asaph Allen (described elsewhere in this issue), a visit to the Explorers Club, an evening devoted to motion pictures of mammals, and the concluding functions at Bronx Park, where the members of the society were the guests of the New York Zoölogical Society, the three days were devoted to the presentation of papers and their discussion. Dr. E. W. Nelson, chief of the Bureau of Biological Survey, presided at the sessions, in the course of which no less than twenty papers were read. Among these the following were contributed by members of the scientific staff of the American Museum: "Close of the Age of Mammals," by Professor Henry Fairfield Osborn and Mr. H. E. Anthony, and "How Near is the Relationship of the Gorilla-Chimpanzee Stock to Man?" by Dr. William K. Gregory. Dr. G. Clyde Fisher presented an attractive series of motion pictures of the gray squirrel at the evening session of May 17.

International Geologic Congress.—The Thirteenth Session of the International Geologic Congress will be held, under the patronage of His Majesty, King Albert of Belgium, at Brussels from August 10 to August 19. In addition to the presentation of papers and their discussion, a number of excursions to sites of geologic interest, as well as to museums and other scientific institutions, are planned. There will be placed on exhibition for the duration of the session documents of geologic interest. President Henry Fairfield Osborn has appointed Professor H. F. Cleland of Williams College and Dr. Joseph Bequaert to represent the American Museum at the session.

American Association of Museums.—The Seventeenth Annual Meeting of the American Association of Museums was held at Buffalo, New York, from May 10 to May 13 inclusive, President Frederic Allen Whiting presiding. The American Museum was represented at the meeting by Dr. Edmund O. Hovey, curator of geology and invertebrate palæontology, and by Dr. G. Clyde Fisher, associate curator of public education. The former spoke on May 11, in place of Director Frederic A. Lucas, who was unable to be present, on the topic "A Natural History Museum and Its Relations to the Community." On May 12 Dr. Hovey had charge of a round table discussion of Natural History Museum Problems, Dr. Fisher being one of the speakers. It was announced that Mr. Herbert P. Whitlock, curator of mineralogy, American Museum, would speak regarding "Some Display Devices for Minerals and Gems," but he was unable to be present. Dr. Hovey described the new wire glass gem mounts, and in addition gave an account of the new installation of minerals and gems in Morgan Memorial Hall. Mr. Laurence V. Coleman, until recently chief preparator at the American Museum and now director of the Safety Institute of America, delivered an address on "Museums of Safety." The social features of the annual meeting included a trip by automobile to Niagara Falls, a luncheon at the Niagara Falls Country Club—the association members being the guests of the Buffalo Museums—and a dinner at the Lafayette Hotel. The meeting of next year, to be held at Charles-ton, South Carolina, during the first week of April, will be in celebration of the One Hundred Fiftieth Anniversary of the Museum Idea in America.

British Association for the Advancement of Science.—The Nineteenth Annual Meeting of the British Association for the Advancement of Science will be held at Hull, under the presidency of Professor Sir C. S. Sherrington, during the week of September 6-13. Many scientists will be in attendance, not only from the British Isles but from more distant points as well.

PRIMITIVE MAN

The Life Work of Carl Lumholtz.—On May 5 Dr. Carl Lumholtz died at Saranac Lake, New York. He had an unquenchable interest in all that the remote places of the world have to offer and through his explorations, now in this region, now in that, traversed many hitherto untrodden areas of the earth's surface, enriching scientific knowledge through his published observations and the collections which he made. Speaking of his youth, he wrote only recently (Natural History, May-June, 1921, p. 226): "Love of nature took stronger and stronger hold of me and one day it occurred to me what a misfortune it would be to die without having seen the whole earth." That ambition never weakened. It prompted him to penetrate the wilds of Australia and share the life of the savage, to journey into unknown parts of Mexico not once but repeatedly, to enter the interior of Borneo and reveal its interest to the world. Even though his strength was failing in the last year of his life, his undaunted spirit would not cry quits. He was making preparations to cross New Guinea from south to north at its broadest point, choosing a route never traversed by a white man.

Dr. Lumholtz' connection with the American Museum was a close one. In 1890 he went to Mexico in the joint interests of that institution and the American Geographical Society, exploring especially in the Sierra Madre region. A later and more extensive expedition to Mexico was made under the sole auspices of the Museum. This expedition lasted from March, 1894, to March, 1897, and during this period Dr. Lumholtz sojourned among Indian tribes about whom little more than their names had previously been known.

Northwest Coast Indians.—On June 9 Dr. Pliny E. Goddard, curator of ethnology, American Museum, left for British Columbia and Alaska, where he will visit the tribes represented in the exhibits of the Northwest Coast hall in order to secure, if possible, additional carvings and totem poles for exhibition purposes. A further reason for making the trip is to obtain a first-hand impression of the region visited and its native tribes, so that the proper local color may be imparted to a handbook on these Indians which Dr. Goddard contemplates writing. He will be accompanied by Lieutenant George T. Emmons, well-known through his publications regarding the Tlingit. In British Columbia he will have as an additional companion Mr. C. F. Newcomb, of Victoria, who for many years has been studying the Indians of Vancouver Island. Dr. Goddard will return to the Museum about September 1.

EUROPEAN ARCHÆOLOGY

Mr. N. C. Nelson's European Trip.—Mr. Nelson, who, in addition to his services as associate curator of North American archæology, has been able to give valuable aid to the American Museum because of his knowledge of Old World archæology, sailed for Europe on June 1, accompanied by Mrs. Nelson. His trip has three major purposes. The first is to arrange, by purchase or exchange, for the acquisition of archæological material at present lacking in the American Museum's collections of prehistoric European objects. The collections of the Museum being more nearly complete for France, Switzerland, and Denmark, it is to these countries that the major attention will be given in the hope of filling the gaps. England and Belgium will, however, also be visited.

A second purpose of Mr. Nelson is to examine the collections of several of the principal museums, especially those covering Old World prehistory, with a view to correcting errors that may have crept into the exhibits in the American Museum, and to gain new ideas, if possible, regarding museum methods, modes of display, etc.

The third purpose is to examine and photograph for the use of the Museum a number of the more important archæological sites, including the Eolithic station at Foxhall, England, to the development of which the American Museum has contributed funds; the Palæolithic type stations in France not already visited; a few typical Neolithic sites, such as Danish shell mounds, the famous flint quarry at Grand Pressigny, Department Indre-et-Loire, France, and some of the Megalithic stations, particularly those in the Morbihan Department, France; a Bronze Age site, preferably a Lake Dweller station, if any of these are being worked; and finally an Iron Age site,—Hallstat if possible, but at least La Tene.

In Paris Mr. Nelson will make his headquarters in the Institut de Paléontologie Humaine, which is under the direction of Dr. Marcellin Boule and l'Abbé Henri Breuil.

Collections in the American Museum.—The Old World archæological collections in the American Museum are richer and fuller than was supposed to be the case before Mr. N. C. Nelson undertook their study. He has made a clear and beautiful arrangement, beginning with the Foxhall flints fashioned by Tertiary Man, and ending with the implements of the Bronze Period. Recent gifts by August Heckscher include the Egyptian succession. Four journeys, exclusive of the present trip of Mr. Nelson, have been made by representatives of the Museum to France and Spain, two by Professor Henry Fairfield Osborn, one by Mr. Nelson, and one by Dr. J. Howard McGregor.

"Fossil Man in Spain."—For the past year, Professor Henry Fairfield Osborn has been directing the translation of the very valuable work by Dr. Hugo Obermaier of the Real Academia de la Historia, Madrid, to be entitled, *Fossil Man in Spain*. The volume is to be published by the Hispanic Society of America, under the direction of President Archer M. Huntington of that institution. Miss Christina Matthew has devoted the last twelve months to the translation. The manuscript has gone backward and forward between the American Museum and the author until, on May 5, Doctor Obermaier writes that he has revised and corrected the entire translation, bringing the work completely up to date. The original volume is regarded by archæologists of Europe as the most authoritative and up-to-date work on the prehistory of Europe —especially since Doctor Obermaier has added his critical knowledge of the intricate outlines of the prehistory of the Iberian Peninsula in North Africa. In this connection it is interesting to record that Doctor Obermaier has recently been appointed professor of the prehistory of man in the University of Madrid, which, under his direction, will doubtless become one of the most important centers of prehistoric study in Europe. He was for many years associated with l'Abbé Henri Breuil in the Institut de Paléontologie Humaine, founded by the Prince of Monaco, in Paris.

FOSSIL VERTEBRATES

The Cohoes Mastodon

having stood in his bones before the public for fifty years has now resumed his natural aspect as he appeared at the time of his lamented death some thousands of years ago during the waning stages of the great Ice Age; and invites you to be present at a private exhibition of his

Reincarnation

Thursday, May 11th, 1922, from 2.00 to 6.00 P.M.

This invitation, extended by the Mastodon to a select number of his personal friends, was sent out by the New York State Museum, to whose initiative the "reincarnation" is due. It is the first life-size reconstruction of a mastodon as it appeared in the flesh. The restoration was made by Messrs. Noah T. Clarke and Charles P. Heidenrich, under the able direction of Dr. John M. Clarke.

It is based upon the careful anatomical study of the fine skeleton found at Cohoes many years ago and now in the Albany museum, upon comparisons with other mastodon skeletons and upon such evidence as has been recorded of the preservation of the hair, etc., in the many finds of this extinct proboscidean in New York State and elsewhere.

It is probably difficult for any one who is not a specialist in anatomy to realize how accurately and certainly one can reconstruct the muscles and outward proportions of an extinct animal from careful study of the bones in comparison with those of its living relatives. Every little peculiarity in each bone, every process or scar has its definite purpose for the attachment of certain muscles, and by its prominence, position, etc., indicates the exact position, the form, and the magnitude of the muscle that is attached to it. By comparison of the skeleton with the skeleton and the muscles and proportions of the modern elephants, one can deduce with very little margin of error the position and proportions of each muscle in the mastodon, and build up its bodily form, as far as the skin, with a reasonable certainty that it is approximately correct. Beyond that, we must admit the security fails us.

There are some records of the preservation of the hair of the mastodon, but nothing so complete as we have of the mammoth, and there are many details left to more or less doubtful inference. However, the general result as shown in the photograph supplied through the courtesy of Doctor Clarke, is as nearly accurate as science can make it, and far more so than the average visitor would probably suppose.

Palæontological Work in India.—Mr. Barnum Brown, associate curator of fossil reptiles, has been working in the Upper and Middle Siwaliks of India, and among the fossil vertebrate material which he has obtained thus far are fine skulls of hippopotamus, rhinoceros, *Samotherium* (a primitive giraffe), camel, elephant, *Sivatherium* (the great antlered giraffe), antelope, *Hipparion*, and two lower jaws of *Palæopithecus* (one of the anthropoid apes). He is continuing work in other localities of the same region with prospects of getting excellent results. The accomplishments of Mr. Brown are the more creditable when one considers the difficulties that beset the path of the field worker in India today. In a country so unsettled credentials must often be obtained before the investigator can move into some promising piece of territory, and delays of this kind are exasperating to the eager collector. Bubonic plague has been raging in parts of the region and has prevented freedom of action. Finally there is the heat. Of this Mr. Brown writes: "The average daily temperature now [the letter was written in April] is considerably over 100 degrees between 9 A. M. and 5 P. M. I work without shelter from 6 until 9 and then it is necessary to put up the tent. By 2 P. M. it is a little Inferno. Then the buffalo go to the river and the natives seek shade trees; only ants and flies remain active."

INSECTS

RESEARCH WORK AT BOULDER, COLORADO.—Dr. Frank E. Lutz, curator of entomology, American Museum, left New York on May 8 in the camp-equipped Ford car of the department, headed for Boulder, Colorado, where he will have the direction of the work planned by the National Research Council's Committee on the Biological Relations Between Flowers and Insects. A postal dated from Boulder at 5:30 P. M., May 21, thus summarizes the trip, "2194 miles in 13 days, 7½ hours. Two punctures, two replacements of bands, one fan belt, and one bolt, the only 'accidents' and repairs." He neglects to add—a fact since learned from his traveling companion—that, industrious collector that he is, he did not fail to swing the net with good results whenever a moment of leisure offered itself in the course of days that were pretty well filled with the work of driving and camping.

INSECT COLLECTING IN HAITI.—A generous donation by Mr. B. Preston Clark enabled the department of entomology of the American Museum to send Mr. Frank E. Watson to Haiti for a continuation of the study of the West Indian insects in which the department has been engaged. The collecting period was from December 22, 1921, to April 12, 1922. Approximately 11,000 invertebrates were taken, chiefly of the class Insecta, and about 300 miscellaneous specimens of fishes, reptiles, etc. The Sphingidæ (hawk moths), which are the insects in which Mr. Clark is most interested, were especially sought. These, unfortunately, proved to be scarce and only about 120 specimens were secured. This scarcity is undoubtedly due to the fact that the collecting was done during the dry season, at which time, however, interesting forms are to be obtained.

Practically all orders of insects are included in the material brought back, the best represented being the Lepidoptera (butterflies and moths), with Hymenoptera (bees, wasps, etc.) and Coleoptera (beetles) in second and third places respectively. Butterfly collecting proved excellent and one could generally secure about thirty-five different species in a single day's catch. The butterflies will, when worked up, probably show at least 115 distinct forms.

A base was established at Port-au-Prince from which trips to various parts of the island were made. In this way collections were obtained from about twenty-three stations, all in the Republic of Haiti. The collecting at Port-au-Prince yielded good results, especially in respect to butterflies. At the southern edge of the city, a long mountain range, known as Morne Hospital, rises to an altitude of more than 3000 feet, and with its numerous ravines and springs affords ample opportunity for research. Two

The "reincarnated" Cohoes Mastodon, recently placed on exhibit at the New York State Museum in Albany other very interesting stations were Manville and Fond Parisien on Lake Assuéi, a large, brackish lake east of Port-au-Prince. Although this region is extremely arid, except where irrigated, many insects were obtained.

LOWER INVERTEBRATES

Recent Acquisitions.—The department of lower invertebrates, American Museum, has recently acquired by purchase or exchange, several interesting additions to its collections. A series of 339 microscopic slides of Protozoa, mounted and identified by Professor Eugene Penard of Geneva, Switzerland, is especially noteworthy, and forms an important enlargement of the protozoan series. Most of the species represented were collected in Switzerland by Professor Penard, though examples from various parts of the world are included. Professor Penard is an authority of international reputation on Protozoa and is the author of many publications on certain groups of that phylum.

An exchange has also been arranged with Dr. Charles Chilton of Canterbury College, Christchurch, New Zealand, and as a result the department has amplified its collections of amphipod and isopod Crustacea from New Zealand, Tasmania, and Australia. Included in the series are two extremely rare and interesting genera, *Anaspides* and *Koonunga*. The former occurs only in the high mountain lakes of Tasmania and the latter in fresh-water pools near Melbourne, Australia. These are among the most primitive members of the higher Crustacea known, and have been preserved relatively unchanged from ancient fossil types regarded as ancestral to modern shrimps, crayfishes, lobsters, and crabs, and other crustacean groups.

Through the efforts of Mr. L. L. Mowbray, until recently director of the Miami Aquarium, an excellent series of over 1100 specimens of the strikingly colored mollusk *Liguus fasciatus* have been obtained. These were collected from a number of localities along the Florida coast and on the Florida Keys. They illustrate to a remarkable degree variation of color within a single species, and hence are well fitted to amplify the series of exhibits in the Darwin hall, illustrating variation as correlated with distribution.

An important collection of European myriapods and isopods has also been secured from Professor K. W. Verhoeff of Munich, whose authoritative works on these groups are well known. This collection will prove a valuable series for comparison with American forms.

PUBLIC EDUCATION

Mrs. John I. Northrop.—In the death of Alice Rich Northrop the school children of New York have lost one of their most sympathetic and inspiring friends. As originator and president of the School Nature League, she brought into their lives something new and fresh and beautiful, something which awakened their minds to the wonder of the world about them and kindled in them the desire to know more about it.

Alice Rich herself grew up as a child of New York, but in the days when flowers bloomed along the East River and birds sang on Forty-second Street. She knew and loved the living things about her long before she began her formal study of botany at Hunter College. After her graduation in 1883, she returned to the college as an instructor in botany. She was a technical botanist of merit and published several articles in *Rhodora* and other botanical journals. Yet it was the broader aspect of education which appealed to her most strongly.

As the demands of industry crowded out the last trees and plots of grass from lower New York, her heart went out especially to the thousands of children who would grow up in ignorance of the very existence of the things which had meant so much to her. She aroused the interest of a group of Hunter alumnæ, formerly students in her classes, and with their aid established flower shows in the public schools and distributed nature material among the teachers. The School Nature League was organized in 1917 with this committee as a nucleus, and Mrs. Northrop's entire time was devoted—without remuneration—to the mission of "bringing the country to the children." The work has grown rapidly during the five years since elapsed until today twenty "nature rooms" are open to the children, rooms containing flowers and branches, insects, birds, four-footed animals, and minerals.

This summer twenty of the honor boys from the "nature rooms" had been promised two weeks' camping in the country. It was while Mrs. Northrop was on her way to Kopec Falls on the afternoon of May 6, to make arrangements for this outing, that the car in which she was driving was struck by a train. She gave her life, as she had given her enthusiasm, her knowledge, her organizing ability, and her influence, to the fulfilment of a noble and far-reaching vision for the children of a crowded city.

The School Garden Association.—On April 29 Dr. G. Clyde Fisher, of the department of public education of the American Museum, was one of the guests of honor, representing President Henry Fairfield Osborn, at the twelfth annual luncheon of The School Garden Association of New York, an association which has as its slogan, "A garden for every child." He was one of the three speakers on this occasion, bringing the greetings of the Museum and emphasizing the value of the work of the school gardens. The other two speakers were Mrs. Emma L. Murray, a member of the present Board of Education, and Mrs. Ruth Russell, a former member of the Board.

Humane Education Poster Contest.—Children are often unwittingly cruel to animals but their sympathies for the dumb creatures are easily aroused and under such circumstances they may become their staunchest defenders. It is the recognition of this fact and of the further fact that what is deeply implanted in childhood is not easily uprooted in adult life that gives practical value to such undertakings as the poster competition recently conducted among the children of the public schools of New York by the Society for the Prevention of Cruelty to Animals and the New York Women's League for Animals. Fifty of these posters were recently on view in the primate hall of the American Museum and compared favorably with those submitted in the Humane Education Poster Contest held last year (see Natural History, March-April, 1921, p. 215).

In viewing the exhibit one was impressed by the variety and fertility of the suggestions made, the many little indicated acts through which these children pointed the way to a better understanding of the needs of their neglected animal friends. "Give us water" was the inscription connected with the picture of a drinking fountain for birds. "Do not tease a captive" appeared under the picture of an irate parrot, with claw raised in defense and beak opened to thrust at its tormentor. "I won't scratch if you won't tease" was the fair proposal ascribed to a cat on another poster. A naïve picture of a little red-coated boy holding a red-and-white-striped stick of peppermint within an inch of the mouth of a complacent lion and entitled "Do not annoy the animals" pointed a lesson that visitors to menageries are still in need of learning. Two posters deprecated the practise—unfortunately still too prevalent among mischievous boys—of attaching tin cans to the tails of dogs. "Stolen feathers" was one of two posters that attacked the abuses of the millinery trade. It showed on the left a bird stripped of most of its plumage, on the right a section of a store window with a feather-trimmed hat offered for sale. The advantages of bird houses were depicted on two posters. The house shown on one of these had as an appropriate inscription over the doorway, "Welcome Inn." The other poster consisted of two pictures separated by a caption. On the right was a desolate wintry scene with two birds perched forlornly in the leafless branches of a tree; on the left a similar scene transformed by summer—the fields green and a cosy little bird house provided, on the roof of which one bird was seen taking its airing while another was directing its homing flight toward it.

Not only was provision made in these posters for the comfort of animals, even their morals were safeguarded. A well-executed picture of a parrot was given the amusing caption, "Don't teach him bad language." Another skilful piece of humorous depiction that calls for special emphasis consisted of a central field bearing the caption, "Be kind to animals for you are one yourself," and decoratively flanked on each side by sprigs of pussy willow—each blossom, without essential sacrifice of its flower-like character, literally made a "pussy" by the addition of a round, bewhiskered head with up-pointed, triangular ears, and a long, curling tail.

This is the third consecutive year that exhibits of posters submitted in the successive Humane Education Poster Contests have been placed on view in the American Museum, and this fact among many others evidences the continuing interest of the Museum in the nature work of the public schools. Provision for "instruction in the humane treatment of animals and birds" in the public schools was made in Article 26-B, added to the education laws of the State of New York in 1917. The states of Connecticut and Pennsylvania have similar provisions.

GEOLOGY

Emerson McMillin.—Through the death on May 31, 1922, of Mr. Emerson McMillin, head of the banking firm of Emerson McMillin & Company and other important financial and commercial enterprises, the Museum has lost a friend of many years' standing. Born at Ewington, Ohio, in 1844, he was a veteran of the Civil War. After the war he became interested in the manufacture of illuminating gas and later in the mining of iron ore, and the manufacturing of iron and steel, but he devoted all his spare time to study of the sciences bearing upon his business interests. In 1891 he came to New York to enter the larger field of finance, where he specialized in matters relating to these fundamental products on which so much of our national welfare is based. He was a man of indomitable energy and fertile brain, who made himself felt in every field of activity into which he entered.

Mr. McMillin's chief interests outside of his business affairs lay in art, a field in which he was a collector of exceptional discernment, and in movements for civic betterment. As another avocation he maintained an interest in science, and particularly in civil and mechanical engineering, chemistry, and geology. This led him to make important financial contributions to the work of various institutions, notably the University of Ohio, the New York Academy of Sciences, and the American Museum of Natural History. He served as treasurer of the Academy for several years and as its president in 1912 and 1913. While he was president, he started two enterprises at least from which the Museum has derived benefit. Realizing the importance of having in New York a central station for the recording of earthquake shocks and tremors, he authorized the purchase of a standard seismograph, which was to be the property of the New

EMERSON MCMILLIN

York Academy of Sciences, but was to be deposited and installed at the Museum. In carrying out his wish that the instrument be made accessible to the public as an exhibit a Mainka seismograph, with heavy masses of one thousand pounds each, was procured and set up in a convenient place on the ground floor of the building. The second of these enterprises was the natural history survey of Porto Rico, which was begun in 1913 by the New York Academy of Sciences with the coöperation of the government of Porto Rico, the American Museum of Natural History, and Columbia University. In the early days of the survey Mr. McMillin gave important financial aid to the project.

He was a man of forceful enterprise and broad mind, one of those pioneers in science as applied to industry whose number is continually growing smaller. At the same time he contributed largely of his abundant means for the advancement of pure research. He was a kindly man, the extent of whose charitable interests will never be known though they were world-wide in their scope.—Edmund Otis Hovey.

The Geological Society of China.—On March 23 there was held in Peking the inaugural meeting of the Geological Society of China, referred to as the first society devoted to the advancement of pure science which has been initiated and organized by the Chinese themselves in their own country. Among the speakers were Dr. H. T. Chang, the president of the society, Dr. V. K. Ting, the honorary director of the Geological Survey of China, Mr. Roy Chapman Andrews, the leader of the Third Asiatic Expedition, Dr. Davidson Black, director of the anatomical department of the Peking Union Medical College, and Dr. E. E. Ahnert. To Dr. Charles P. Berkey, the geologist of the Third Asiatic Expedition, was accorded the honor of delivering the first scientific address before the new society.

Mr. Andrews expressed the opinion that the occasion marked "a new era in the scientific life of China" and referred to the fact that the country offers "a field for investigation which is unrivalled in importance and interest." In this verdict Dr. Black, the next speaker, concurred, and calling attention to the fact that "our conception of Tertiary mammalian succession has been altered during the past fifty years through the systematic palæontological research carried on in America and Europe," expressed the opinion that "one may expect as great or even more revolutionary results to be forthcoming as the outcome of similar investigations in this vast country, closely associated as it is with the probable center of mammalian radiation."

FISH

A Record Dolphin.—The first "record" fish to be presented to the anglers' collection, to be installed in the new hall of fishes of the American Museum, is a dolphin 5 feet 3 inches long, weighing 37 pounds. It was taken off Miami, Florida, by Mr. Henry Stevens of Lavalett, New Jersey, on February 3, 1918, and is 3 pounds heavier than any other previously recorded specimen of this fish caught by rod and reel. The dolphin is a truly pelagic fish that is found in all the warm seas of the world. It associates in small schools, preying almost exclusively on flying fishes, which must gain the air quickly if they would escape this swift swimmer. A device that sailors on deep-water sailing ships have employed to catch the dolphin consists of a hook set in a piece of wood over which a white rag is draped. This lure is barely allowed to touch the water before it is jerked out again and doubtless simulates to the dolphin in the water below the behavior of its prey.

The Retiring Commissioner of Fisheries.—Dr. Hugh M. Smith terminated recently a connection with the Bureau of Fisheries that extended over more than three decades. It was in 1886 that he entered this Bureau (then known as the United States Fish Commission) as assistant. He successively held the offices of assistant in charge of the division of fisheries, assistant in charge of scientific inquiry, director of the biological laboratory at Woods Hole, Massachusetts, deputy commissioner of fisheries, and from 1913 to the time of his retirement, commissioner of fisheries.

The New Commissioner of Fisheries.—Mr. Henry O'Malley, appointed commissioner of fisheries, to fill the vacancy caused by the retirement of Dr. Hugh M. Smith, has been connected with the Bureau of Fisheries for a number of years, devoting himself more especially to the government work on the salmon industry of the west coast. An expert fish culturist, he has supervised the extensive government fish-hatchery work in the North Pacific States. He is a keen fisherman and it is hoped that the rod and line anglers of the country, who seem to be the group most interested in the conservation of fish life, will find in him a friend at court.

"Ocean Research and the Great Fisheries."—Mr. John T. Nichols, curator of recent fishes, American Museum, has recently issued in the *Evening Post* a review of *Ocean Research and the Great Fisheries*, by G. C. L. Howell, a book which "gathers the scientific results from different sources into a compass where it will be available and understood, for persons interested in the fisheries as a business or as an economic problem." Mr. Nichols adds in closing his review, "For any one to whom the mysteries of the great ocean appeal it will prove a delightful book to browse through."

Northerly Record of Giant Ray.—Dr. E. W. Gudger has contributed an article to a recent issue of *Science*, entitled, "The most northerly record of the capture in Atlantic waters of the giant ray, *Manta birostris*." This article considers in detail the capture of the giant ray the photograph of which forms the headpiece of Dr. Gudger's article in this issue of Natural History.

CONSERVATION

The Transvaal Game Protection Association.—President Henry Fairfield Osborn, of the American Museum, has received notification under date of April 4 that he has been elected an Honorary Member of the Transvaal Game Protection Association. This distinction, conferred upon an individual who has thrown the full weight of his influence into the battle that is being waged for the more adequate protection of the wild life of the world, is one to be cherished, for through the efforts of its president, Dr. A. Haagner, and those associated with him, the Transvaal Game Protection Association has taken a place in the forefront of the agencies that are battling for conservation. Dr. Haagner has shown tireless zeal in endeavoring to stem the tide of destruction that threatens to engulf the wild life of Africa with the same ruthlessness with which it has swept away the fauna of other continents.

That there can be no relaxation of energy is the inevitable conclusion to be drawn from a reading of the annual report for 1921 of the central executive committee of the Transvaal Game Protection Association, which issues the warning that unless the local public interests itself wholeheartedly in the protection of its fauna, the Transvaal will soon be as denuded of game as the Cape. The biltong, or jerked beef, hunters are a standing menace. It is charged in the report that in the principal game districts they made their appearance at the very opening of the shooting season and remained to the end, "exterminating everything they came across, regardless of variety, age or sex." Another agency of destruction is the "Kaffir" dog. Many of these dogs are roaming the veldt notwithstanding the care exercised in issuing licenses. It is gratifying to learn that during 1921 two hundred convictions of apprehended poachers were obtained but the figure is also an index of the wide spread of this practise, so difficult to detect in a land where, due to financial stringency, the police force has been depleted in numbers. One of the menaces in the situation is the fact that, owing to the clamor raised by certain elements in the population, the Provincial administration has been browbeaten into doing away with game reserves that should have been maintained as such. The nationalization by Act of Parliament of these reserves, thereby removing them from the jurisdiction of the Provincial Councils and rendering them safe for all time, is one of the recommendations made by Dr. Haagner in his presidential address and is to be commended heartily as a step in the interests of the people as a whole as against the selfish claims of particular sections.

CONFUCIUS ON THE VALUE OF RESEARCH

"In a recent issue of the *Chinese Students' Monthly* Prof. Frank J. Goodnow quotes from the *Great Learning* of Confucius as follows:

'The ancients, when they wished to exemplify illustrious virtue throughout the empire first ordered well their states. Desiring to order well their states they first regulated their families. Wishing to regulate their families they first educated themselves. Wishing to educate themselves they first made pure their purposes. Wishing to make pure their purposes they first sought to think sincerely. Wishing to think sincerely they first extended their knowledge as widely as possible. This they did by investigation of things.

'By investigation of things their knowledge became extensive; their knowledge being extensive, their thoughts became sincere; their thoughts being sincere, their purposes were made pure; their purposes being made pure, they educated themselves; being educated, their families were regulated; their families being regulated, their states were rightly governed; their states being rightly governed, their empire was thereby tranquil and prosperous.'"

The above extract is taken from an article by McAlister Coleman in the *New York Evening Post* of March 27. Mr. Coleman goes on to comment on the important place that was assigned to the spirit of disinterested research in the ancient culture of China four hundred years before Christ and the part that this attitude of mind has played in the development of Chinese civilization.

The spirit of research, the desire for knowledge in and for itself, quite aside from any question of material profit, has played a part no less fundamental and important in the development of our Western civilization. The beginnings of science lay not in a desire for profit but in a desire for knowledge. The profit came afterward, and rather incidentally. The vast expansion of material advantage and prosperity that have flowed from the pursuit of science has tended perhaps to obscure this primary aspect of research. Too often its value is measured in terms of its material applications. We sneer at "pure" science and ask, "What use is it?" But research is surely worth while if it leads to a better knowledge and understanding of the world we live in, to a broader and more just appreciation of ourselves, of our relations to our fellow men, and of our place in the universe. There is no better training in straight thinking and fair dealing than the practical study of nature and scientific research afford. As a sound training for life these things are as important today as they were in the days of Confucius.

—W. D. M.

Exhibition of Photographs of Mammals.—In the March-April issue of Natural History (pp. 191-192) attention was called to the remarkable exhibit of photographs of mammals at the American Museum. It was not easy for the judges —Messrs. Wilfred H. Osgood, chairman, Witmer Stone, H. E. Anthony, Charles R. Knight, and James L. Clark—to choose among 1654 pictures of such a high standard of excellence, submitted by 139 competitors, the small total of 16—less than one in a hundred—to which prizes or honorable mentions were awarded. The successful contestants were:

I. PHOTOGRAPHS OF MAMMALS IN THE WILD STATE

First prize	John M. Phillips	Mountain Goat
Second "	Norman McClintock	White-tailed Deer
Third "	Edmund Heller	Mountain Sheep
Honorable Mention		
First	Carl E. Akeley	Hartebeest
Second	Donald R. Dickey	Deer
Third	Kermit Roosevelt	African Elephant
Fourth	Edward Mallinckrodt	Brown Bear
Fifth	Donald B. MacMillan	Polar Bear

II. PHOTOGRAPHS OF MAMMALS IN CAPTIVITY

First prize	Elwin R. Sanborn (New York Zoölogical Park)	Chimpanzee
Second "	J. E. Haynes	Bison Stampede
Third "	W. Lyman Underwood	Bay Lynx
Honorable Mention		
First	Mr. & Mrs. Ernest Harold Baynes	Wolf
Second	J. B. Pardoe	Flying Squirrel
Third	Joseph Dixon	Cougar Kittens
Fourth	Leland Griggs	Fox Head
Fifth	Arthur H. Fisher	Lioness

The judges further desired to express their high appreciation to two exhibitors whose entries were not in the competition:

(1) To Mr. Herbert Lang, whose large and fine series of 329 photographs added so much to the interest of the entire display;

(2) To Honorable George Shiras, 3d, whose early work in flashlight photography established such a remarkable record and inspired others to hunt with the camera in place of the gun;

And lastly, to Mr. A. G. Wallihan, the great pioneer in wild life photography in America, whose successful endeavors and early publication along these lines has encouraged so many to follow his footsteps.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Patron: Mrs. Hans Zinsser.

Life Members: Messrs. Hugh D. Auchincloss, Howard Bayne, Sidney W. Noyes, and Herbert Prescott Shreeve.

Sustaining Members: Mrs. Charles P. Soden and Mr. George T. Fillius.

Annual Members: Mesdames Josephine McWilliams, Ferris J. Meigs, Philipin Schwarz; the Misses Molly Boocock, Marion C. Bourne; Doctors Russell S. Fowler, Harry H. Shapiro; Messrs. Temple T. Berdan, Charles C. Bolton, J. G. Butler, Jr., Michael H. Cardozo, Jr., Morse K. Cohen, R. A. Corroon, Arthur J. Cote, Horace Flanigan, Julius H. B. Fogg, Robert Frothingham, H. B. Goldberg, Rawson B. Harmon, George Walter Hawkes, John H. Hord, William Jared Knapp, Holger E. Krause, Lindsay P. McKinley, Gardner W. Millett, Donald S. Ruggles, Nat. C. Strong, and Caspar Whitney.

Associate Members: Mrs. Joseph I. Eldridge; the Misses Miriam C. Cassel, Eleanor J. Chadeayne, Marion McKinney; Count Guillaume de Grunne; Doctors James Beveridge, Harold Childe Bryant, H. H. T. Jackson, Frederick B. Moorehead, Paul G. Wooley; the Reverend Endicott Peabody; Professors Erwin H. Barbour, E. B. Renaud; Messrs. Alfred H. Berry, Gordon R. Campbell, J. A. G. Carson, Wm. Dove, M. L. Gochenour, Julius Goslin, Jack A. Isaacs, R. C. Middleton, Sol. Peskind, M. M. Pratt, W. A. Selvidge, Herbert L. Stoddard, Jay Quincy Ward, Daniel D. Wells, I. T. Yoder, and John B. Yost.

NATURAL HISTORY

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THE JOURNAL OF THE AMERICAN MUSEUM

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

JULY–AUGUST, 1922

[Published August, 1922]

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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NATIVE HUNTER AND TAKIN

Not more than six or seven white men had killed the Shensi form of takin before the author entered the mountains where it is found and obtained two specimens of this spectacular animal, which is related to the chamois, goral, serow, and the so-called Rocky Mountain goat. Later, native hunters whom he left in the region obtained three additional specimens. It is the intention to use these five animals in a group that will be one of the arresting features of the proposed Asiatic hall of the American Museum

NATURAL HISTORY

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HUNTING TAKIN IN THE MOUNTAINS OF SHENSI

BY

ROY CHAPMAN ANDREWS*

SHORTLY after Mr. Pope left for the south I completed my own preparations for a visit to the Tsinling mountain range, southwest of Sianfu in Shensi Province. The object of this expedition was to obtain specimens of the rare takin (*Budorcas bedfordi*). This species, which was discovered by Mr. Malcolm Anderson, while on the Duke of Bedford's expedition, under the direction of the British Museum of Natural History, is one of the rarest and most interesting animals in China. The takin belongs to a group known as the *Rupicaprinæ*, which comprises the chamois, goral, serow, takin, and the so-called Rocky Mountain goat of America. They are often spoken of as the "goat-antelopes" because they hold an intermediate position between the true goats and the antelopes.

This group is an excellent example of one the members of which have migrated both to Europe and America from a central Asian point of origin. Although takin of different species are found in Assam and western Szechuan along the borders of Tibet, the Shensi form is very much less known and has been killed by not more than six or seven white men. We were particularly anxious to get a complete series for a group to be placed in the hall of Asiatic life that will be located in the proposed southeast court building of the American Museum, but it was important also to make a reconnaissance of the Tsinling mountain range.

This vast chain of mountains, which extends east and west through the center of China, appears to have been a faunal divide even in early geological times, as it is today. It has never been carefully investigated and is one of the most attractive fields for the accomplishment of a splendid piece of zoölogical work, both from the standpoint of species new to science and from that of distribution.

I invited Captain W. F. Collins, of Peking, to accompany me on this trip and was particularly fortunate in my choice of a companion. Not only does Captain Collins speak Chinese fluently, but he has a very thorough knowledge of Chinese characteristics, which knowledge in a province such as Shensi, where there is a good deal of anti-foreign feeling, proved to be of invaluable assistance.

Our mule trip of seven days from the end of the railroad to Sianfu, the ancient capital of China, was without incident. Although we had no difficulty in getting into Sianfu, it was somewhat of a problem to get out, because the new Tuchun, or military governor, was carrying on operations against the troops of a certain General Chang Fei-sheng. A full-sized battle was raging not more than five miles to the west of the city and directly on the road which we wished to take. Captain Collins and I were warned that

*Leader of the Third Asiatic Expedition which the American Museum is conducting in coöperation with the American Asiatic Society and *Asia*.

A varied bag, consisting of pheasants, hares, snipe, and geese

we were probably putting ourselves in a very dangerous position by leaving the city, but we felt confident of our ability to get to the Tsinling Mountains without serious difficulty.

By making a wide detour as soon as we left the city gates, we avoided the fighting area and after crossing the Wei River arrived at the base of the mountains four days later without having had the slightest trouble. Our destination was the Tai-pai-shan (Great White Mountain), a series of peaks almost in the center of the Tsinling range and the exact locality from which the first specimen of the Shensi takin had been obtained by the late Malcolm Anderson. Our way led up a rocky river bed along the cliffs at the side, and late on the night of the fifth day we stumbled through the darkness into the little mountain village of Lingtaimiao. We camped in a temple which has been occupied by every one of the foreigners who have killed the Shensi takin. Other sportsmen have had the advantage of a famous old hunter named Yong, but we learned that he had died two years previously and we had to depend on his son, a youngster of eighteen, who was afflicted with laziness to a remarkable degree, even for a Chinaman.

For two days it rained steadily and the summits of the peaks were enveloped in a thick gray blanket, but my traps, which had been set in the fields near the temple, yielded a surprisingly interesting collection of mammals. On the third day we left with eight carriers to make camp far up the mountain at an altitude of 11,000 feet. Nowhere in China had either of us seen such great numbers of pheasants as we found in the river bottom. We shot one woodcock, four hares, and nineteen pheasants without going more than a hundred yards from the trail. Four miles from the temple we entered a deep, densely forested gorge, which led rapidly upward toward one of the highest peaks. At night we camped beside an overhanging ledge of rock under a beautiful, starlit sky. We had come up through an interesting series of floral zones. On the lower parts of the mountain there is a mixed forest of oak, pine, larch, and birch, then a clear-cut area of dwarf bamboos, and finally the rhododendron zone. In New York we know rhododendrons only as beautiful shrubs, but here we found them as trees reaching a height of twenty or even thirty feet, their tops spreading out and interlacing to form a canopy of twisted branches and dark green leaves.

When we passed upward out of the high rhododendron forest, we reached the dwarf trees, which were only six or eight feet high, but so closely intergrown that it was well-nigh impossible to force our way through them even when we followed old woodcutters' trails. Above the rhododendrons stretched the peaks, here and there giving sustenance to a stunted larch. Our camp was in a beautiful meadow beside an underground stream, which came to the surface in a little well just at the door of the tent. Below and to the east was a wonderful panorama of forest-clad peaks; to the west a great rock-slide which had thundered down from a granite pinnacle, possibly hundreds of years ago. To the north a rounded ridge lay thick with snow. It was a wild place, fit habitat for one of the strangest animals of the world.

We were among the clouds, and masses of vapor were continually weaving in and out between the peaks and suddenly enveloping us in a damp gray blanket. We could never predict more than half an hour in advance what the weather would be. The sun usually rose in a sky of brilliant blue, but at any moment clouds might roll in from below or above and a drizzling rain begin. During the fourteen days we were hunting takin we were not dry more than a few hours at a time. For two days we hunted unsuccessfully on the peaks surrounding camp, finding only a few very old signs of takin. On the morning of the third day, before we started out, one of the carriers built himself a little shrine not far from the tent, produced several sticks of incense from somewhere among his voluminous coats, and proceeded to sacrifice at his little altar, placing several tiny cups of rice and food beside the incense sticks. He assured us that we would find takin that day and, sure enough, we did.

About noon, after an exhausting scramble through the rhododendrons to reach the peaks almost opposite camp, we saw six yellow specks moving about in the dwarf bamboo on the steep side of a mountain not more than seven hundred or eight hundred yards away. Through our field glasses we could see the takin plainly and never have I had such a thrill upon beholding an animal for the first time. The brutes, almost as large as small cows, were climbing about among the bamboos on the seemingly perpendicular wall. Their golden yellow hair contrasted strangely with the green of the bushes, and in looking at them we could think of nothing but the reincarnation of the Golden Fleece.

Although the animals were almost within long rifle shot, they were on the opposite side of a cañon with walls dropping sheer for more than a thousand feet, and the only possibility of a successful stalk was to go around to them. This took six hours of the hardest work I have ever done and it was a short time before dark ere we arrived, absolutely exhausted, at the base of the cliff where we had seen them.

We fought our way to the summit only to find that the animals had gone over the other side and were out of reach, for night was closing in. There was nothing for us to do but return to the bottom of the gorge where we hoped that the two men whom we had sent back to camp for food and our sleeping bags would possibly find us. It was raining steadily, we were soaked to the skin, our hands were scratched and torn, and we were faint from lack of food, for we had had nothing to eat since morning. It was rather a cheerless prospect as we stood about a tiny camp fire, trying to dry bits of our sodden garments and keep our teeth from chattering. Our chief worry was that we had no food for the next day and we knew that it would be

TYPICAL TAKIN COUNTRY

It was over these mountains that the animals were hunted. The two secured by the author were shot on the ridge seen in the background

A CAMP IN THE MOUNTAINS

Under overhanging rocks like the one in the picture the party in search of takin would camp at night. Captain W. F. Collins and three natives are seen relaxing after the hardships of the hunt

A SPLENDID RAM

This animal was secured by the author in Shansi, one of the provinces bordering Mongolia on the south well-nigh impossible to face the hard climbing which was between us and the takin if we did not have something to eat.

About ten o'clock, as we were trying to build a shelter of bamboo branches, the two men whom we had sent back to camp appeared with our sleeping bags and a little food. They had seen the light of our fire when nearly three miles distant and had made their way to it in almost total darkness over cliffs which I should not care to travel again even in daylight. To make a long story short, we found the takin at noon the next day and I was fortunate enough to get two, a splendid female with her half-grown calf. Although I had wanted to kill a takin for many years and had dreamed about it almost every night for weeks, I was so exhausted physically that when the actual moment for shooting came I had not the slightest thrill of pleasure, only a feeling of great relief that the hunt was ended.

We photographed and skinned the takin and started back for camp. Laden down as we were, we could not go back the way we had come, and it was two days before we reached our destination, which in a straight line was less than a mile distant.

A day of hunting in the vicinity of camp was no more successful than our earlier attempt had been to come upon takin in that area. Accordingly Collins and I set out with three bearers carrying our sleeping bags and rice enough to last for a week, with the intention of striking into the mountains near the place where we had shot the takin cow.

We were gone six days, and although we followed takin tracks for two or three days at a time, we did not see another takin. At night we slept under overhanging rocks wherever we happened to be, crawling into our sleeping bags almost too exhausted to cook our rice. Our hands and legs were in a terrible condition from deep scratches and superficial infection, and our bodies were bruised from innumerable falls, but still there was always the hope of finding takin the next day. At last we were forced out of the mountains by a heavy snow storm, which made hunting absolutely out of the question.

I did not have sufficient specimens, but had collected rocks, vegetation, and all material necessary to reproduce the group in the American Museum. We decided to leave two of our native hunters on the spot with instructions to wait until after the snow had melted and not to return without two or three takin. We thereupon descended to the little temple at the foot of the mountain to obtain mules for the journey back to Sianfu and to supply our native hunters with the proper collecting outfit. While we were sojourning at the temple, the village was thrown into a turmoil one evening by the appearance of two hundred brigands. These were the former soldiers of General Chang Fei-sheng, who would be shot if they returned to their own homes and who had consequently taken to the hills. They were a rough-looking crowd, each man carrying two bandoleers of cartridges, one or two Mauser pistols, a bayonet scabbard, and a rifle or two.

A short time after their arrival we received a visit from the chief; he had a cut in his hand and when I offered to dress it for him, he was very grateful and asked if I would attend to the wounds of several of his men. The result was that I spent all of the next day and a part of the day following that in patching up bodies, heads, legs, and arms. When we were ready to leave, the brigand chief offered us an escort until we were out of the territory which his men were holding.

Although these bandits treated us so courteously, I subsequently learned from my native hunters that, after the brigands had exhausted all the food in the little village, they took several of the most well-to-do farmers and tortured them by slowly roasting them over hot coals until they had revealed where food and money had been hidden. The two hunters that we had left behind became so frightened at these proceedings that they fled back into the mountains for two days and in this way happened upon a fine shooting locality where they found abundance of game. Not only did they kill three splendid takin, but obtained a bear, wild pig, deer, and serow, as well as a magnificent collection of small mammals, many of which are undoubtedly new to science.

Because of the disturbed state of affairs in Shensi, I was greatly worried about the safety of these men, but I am glad to say that they reached Peking, all their collections intact, without having had any trouble.

After a stay of a few days in Peking I left again for a trip along the south Mongolian frontier. My companion was Lieutenant-Colonel H. St. Clair Smallwood, and we visited a region contiguous to the one from which Mr. Caldwell and I had secured a series of mountain sheep some years previously. The railroad has been extended to within six miles of the place where Mr. Caldwell and I hunted and has sounded the death knell of the splendid sheep and wapiti which still exist in the isolated range of mountains that occupies that area. I venture to predict that within three or four years at the most these animals will become almost totally exterminated.

Our hunt was very successful. We obtained a series of small mammals which are of considerable importance, as well as eight sheep, two wapiti, a wolf, and a roebuck. I became ill after three weeks and had to return to Peking, while Colonel Smallwood visited the wapiti locality alone, and the credit for having obtained the specimens of this important animal is due entirely to him.

After a week in bed I equipped three of my native collectors and dispatched them to various promising localities to carry on the winter zoölogical work. We have now collectors in five different provinces of China, and there is a steady flow of material arriving at the headquarters in Peking.

Typical sheep ground in northern Shansi

Courtesy of Monsieur V. Forbin

The only creature now alive that looked upon Napoleon

HISTORIC TORTOISES AND OTHER AGED ANIMALS

BY

FREDERIC A. LUCAS*

OUR good friend M. Forbin, to whom we are indebted for many interesting items and illustrations, recently sent us a photograph of the only creature now alive that saw the great Napoleon. This is a tortoise from Aldabra that is still living a peaceful existence at St. Helena though Napoleon passed away a century ago (May 5, 1821). How old this tortoise was when brought to St. Helena, we know not, but venerable as it seems to us with our allotted span of threescore years and ten, its age is exceeded by that of another tortoise that is—or was recently—living in the Island of Mauritius whither it was brought from the Seychelles many years before, being even then of unusual size. In Mauritius it became a national possession and in 1810 was specifically mentioned in the treaty by which the French ceded Mauritius to England. "It is said" to have lived in Mauritius for at least seventy years previously, so that

*Director of the American Museum

it is pretty safe to conclude that it is at least 150 years old.

Unfortunately this tortoise has been confounded with another brought to England from Mauritius in 1897, through the efforts of Sir Walter Rothschild. The latter specimen originally came from South Aldabra, was taken to Egmont Island, and thence to Mauritius, before being transferred to England. In *All About Animals*, p. 171, incidents in the history of this tortoise are assigned, in error, to the tortoise that figured in the treaty—or as the writer in *All About Animals* will have it, in two treaties—with the result that Aldabra is mentioned as the place of origin of the historic tortoise of Mauritius, instead of the Seychelles, its true birthplace. Through the same error, the historic tortoise is, in the account given in the volume mentioned, transshipped to England in 1897, although the very fact that it was regarded by Sir Hubert Jerningham as Government property, and therefore not subject to sale, made such a transfer impossible. This tortoise remained at Port Louis, Mauritius, whereas the tortoise from South Aldabra is preserved today in the Rothschild Museum at Tring; the latter was certainly more than 150 years old at the time of its death, probably nearer 200, and enjoys the distinction of being, aside from fossil specimens, the largest known tortoise, having, it is reported, attained a weight of 560 pounds.

Still another Ancient of Days was a tortoise from the Galápagos, taken to Honolulu probably by some whaler during the golden days of the whale fishery, before 1850, and given to Paki, father of Mrs. Bernice Pauahi Bishop, by whom it was christened Maeleka. Some time before his death in 1855 he gave the tortoise to Queen Liliuokalani, who later placed it in Kapiolani Park. From there, at the instance of Sir Walter Rothschild, it was sent to England in 1915, where it died two years later.

These three "historic tortoises," so far as we can determine, attained the greatest ages recorded for any animals, being the oldest known members of an ancient and long-lived race, for even such little species as our box turtle reach a good old age. True, the most accurate record, that of an individual that was caught and marked from time to time, is only 41 years, but there is a rather reliable account of a tortoise 110 years old and a less reliable note of a specimen marked by Daniel Webster, though here I confess that I have lost the published account.

This naturally leads to the questions: what is the limit of life, what animals live the longest, and what is the age they attain?

There are plenty of statements that fish are known to attain, and birds have reached, many scores of years, but when an attempt is made to verify these statements, they resolve themselves into matters of hearsay or of belief rather than records of facts. We naturally associate size with age, for the bigger an animal, the longer should it take to reach that size, but while we are apt to credit such creatures as whales with a century or more of existence, there is reason to believe that they are by no means as venerable as they appear, and the same seems to be true of elephants, which reach their full stature in comparatively few years.

Thus, the once-famous Jumbo, whose name has been embodied in the dictionary as a synonym for all things big, reached his full height and weight in twenty-one years, growing in this time from an infant three feet high, weighing a few hundred pounds, to a towering adult eleven feet in height and weighing six and a half tons.

As for the Indian elephant, Mr. Pocock, from a study of the teeth, estimates the average duration of life at about seventy years and, so far, I have not been able to lay hands on an authenticated record of an elephant older than this, although these animals "are said" to attain an age of 120 years.

THE LARGEST RECENT TORTOISE

Exclusive of fossil specimens, this tortoise from South Aldabra, now preserved in the Rothschild Museum at Tring, is the largest known tortoise. At the time of its death it was between 150 and 200 years old and weighed, as recorded by Dr. Hans Gadow, 560 pounds. The history of this tortoise, as well as that of other noteworthy specimens, is given by Doctor Gadow in the volume *Amphibia and Reptiles* in The Cambridge Natural History

This tortoise lived for more than half a century after having been given to Queen Liliuokalani of Hawaii by Paki, the father of Mrs. Bernice Pauahi Bishop, being even then of so conspicuous a size that it was deemed a present worthy of royalty. It came originally from the Galápagos Islands, sojourned for many years in the Hawaiian Islands, was finally transshipped to England, and died there two years after its arrival

Personally, I confess that I believed whales required many years, possibly one hundred, to reach their full growth, until I became somewhat intimately acquainted with them at Balaena, when my ideas underwent a radical revision. Briefly, if whales continued to grow indefinitely, there would be an infinite variety of sizes; as a matter of fact they fall into rather few categories and there are a not inconsiderable number of whales of moderate bulk that are, as shown by the condition of their bones, indubitably old, or at least adult. How long it takes to reach a length of 80 feet, with a known weight of 60 tons, or the maximum of 103 feet, and an estimated 80 to 90 tons, we know not, but the chances are that it takes far less time than is generally supposed.[1]

There are some animals, or groups of animals, such as fishes and reptiles, that seem to have no fixed limits of life and growth and thus appear to present great possibilities in the matter of age. Unfortunately, there are few records on which to base any trustworthy conclusions and the most reliable of these show that under favorable conditions some reptiles grow much more rapidly than is generally supposed: the big alligator in the New York Zoölogical Park grew from seven feet to twelve feet in length in twelve years, though theoretically it should have taken him at least half a century to attain such an unusual size, almost the maximum for an alligator.

The great size of the tortoises referred to, which reached a weight of *at least* 450 pounds, probably even more, was supposed to indicate a proportionately great age; in fact, a specimen that died at the London Zoo was stated by the papers to be 400 years old; but another, brought from the Galápagos by Mr. Edmund Heller, in seven years increased from 29 pounds to 295 pounds and in less than ten years reached a weight of 350 pounds. Had not the career of this tortoise unluckily been

[1]Whales seem to reach their maximum size in the South Atlantic: examples of the "blue" or "sulphur-bottom whale," 105 and 108 feet in length respectively, have been reported from the whaling station at South Georgia, and the British Museum party measured specimens up to 103 feet long.

cut short by kidney trouble, induced by living for part of the year in a moist climate on damp ground, it might by this time have attained the record size for tortoises.

If reptiles grow so rapidly nowadays, they probably did so in the past, and Brontosaurus and his kindred may not have taken a century or two to reach their seventy or eighty feet of length, as has so often been supposed.

Mere size, then, is not a safe criterion of the age of either mammals or reptiles, and needs to be checked by a knowledge of the conditions under which the animals have lived.

Fish stories and fishy have become "familiar in (our) mouths as household words," so we are not surprised to find among the "it is said's" and "it is reported's" that fishes are credited with the greatest span of life ascribed to animals, pike and carp holding the places of honor with *reputed* ages of from 200 to 375 years. Oddly enough, most of these alleged records are reported from French ponds at Chantilly, St. Germain, and Fontainebleau, during the German occupation of 1870.

Records of birds are rather disappointing, for just as the greatest creature is apt to shrink before the application of a two-foot rule, and fish when weighed in the balance are often found woefully wanting in avoirdupois, so the ages of birds become wonderfully less when their claims to longevity are investigated.[1] Parrots stand well toward the head of the list, with numerous records on good authority of various species attaining an age of from fifty to eighty years. Geese and swans, too, are long-lived, and include some possible centenarians, though just as the census returns show a part of womankind to be much younger than it looks, so there are few reliable records of swans more than seventy years old.

There have been many attempts to estimate the ages to which various animals might attain under favorable circumstances, but none of these estimates based on size, time required to reach maturity, period of incubation (in birds), is borne out by the known facts. The best of them is possibly that applied to mammals, that their normal life is five times that required to reach maturity, this being determined by the union of the epiphyses with their adjacent bones.

After all, man, when compared with other animals, does not suffer much in the matter of longevity, and frequently exceeds the threescore years and ten popularly ascribed to him, though he does not often reach the 120 years allotted in Genesis. In the *Times* for November 6, 1921, Mr. Buck, discussing the span of life, cites from recent death notices seven instances ranging from 102 to 115 years.[2]

In preparing this article I have become more than ever impressed with the truth of the adage that "there is no truth in history." To begin with, I cannot find that there is any such adage, the nearest approach to it being the remark, attributed to Plutarch, "So very difficult a matter is it to trace and find out the truth of anything by history," a remark to which I most heartily subscribe.

[1]The statements in regard to the ages of birds are taken from an article by J. H. Gurney, on the "Comparative Ages to which Birds Live," which may be found in the *Ibis* for January, 1899. It was reprinted, with additions, in the *Osprey* for June, 1899, and the subject of longevity discussed by Doctor Gill on p. 157 of the same number.

[2]The reader is referred also to "The Biology of Death: I—The Problem," by Professor Raymond Pearl, *Scientific Monthly*, March, 1921. Professor Pearl points out (p. 198) that "the most extreme case of longevity which Young was able to authenticate was about a month and a half short of 111 years."

TERNS AND SKIMMERS

Among the most impressive of the bird habitat groups on the third floor of the American Museum is that representing the summer life of Cobbs Island, Virginia. A shell-strewn sand bar seven miles long, and about the same distance from the mainland, this island is an ideal resort for sea birds. Some years ago the bird-life of this island was appallingly depleted through the inroads of the millinery trade, but today it is recuperating. The birds of this habitat group, only a part of which is shown in the picture, were mounted by H. C. Denslow; the background was painted by W. B. Cox. (See page 315)

THE DEPARTMENT OF BIRDS, AMERICAN MUSEUM

ITS HISTORY AND AIMS

BY

FRANK M. CHAPMAN*

THE "large lecture hall" of the first (north) wing of the American Museum in which Professor Bickmore inaugurated his popular lectures to teachers, now holds about one half of the Museum's research collections of 200,000 birds, not one specimen of which was in the building when this hall was opened.

The first time I ever visited the American Museum I found that Sunday—the only day in the week I was free—was the only day in the week that the Museum was closed. Finally, during a vacation period, I entered the bird halls to discover only row after row of birds mounted in stereotyped attitudes on T-perches. Absorbingly interesting they were to me, but the average visitor wandered aimlessly past them. At present Sunday attendance at the Museum is often larger than the total for the remaining days of the week and, from the opening to the closing hour, the hall of habitat bird groups is thronged with keenly interested visitors. These facts give some idea of the growth and development of the Museum's research and exhibition collections of birds.

Without being unnecessarily statistical (the exact data may be found in the *Annual Reports*) let me attempt to present the history of the department which from nothing has attained the first rank in less than fifty years. It will be well, however, to preface this sketch with a word or two on the function of a department of birds, in order that the reader may have some conception of our aims and the measure of success that has attended our efforts to attain them.

AIMS OF A DEPARTMENT OF BIRDS

A museum department of birds should be prepared to answer, so far as existing knowledge permits, any inquiry concerning birds, their place in nature, and their relation to man. This it does primarily through its exhibits, illustrating the structure of birds, their classification and distribution, their habits, their food, and their relation to their environment and to man. There should be (a) synoptic collections showing leading types of birds arranged according to what are believed to be their natural relationships, and (b) faunal exhibits of birds, grouped according to the zoölogical regions they inhabit. This system not only enables the visitor to see at a glance the more characteristic birds of South America, Europe, or Africa, for example, but it permits him to find more readily a given species of a certain country.

First place among faunal exhibits of this nature should be given to one illustrating local bird-life designed especially to help teachers and amateur students. Such a collection, in addition to a systematic series, should include a seasonal one, to be rearranged the first of each month and to include only the birds that are then in evidence.

Accessory groups, including the nest and its immediate surroundings, will illustrate nest architecture in relation to site, and large habitat groups will show the bird and its surroundings, and will afford an opportunity to illustrate not only a bird's haunts but its nesting habits and the relation of its form and color to its environment.

A series of related groups should tell

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LOCAL BIRDS

The local bird collection at the American Museum consists of species found within fifty miles of New York City. It is divided into a systematic and a seasonal series, the latter being changed each month to conform to the development of the ornithological year. The student of local birds is thus enabled to look for a specimen of some species he has recently seen near New York among a few score birds rather than among 12,000. The local collection occupies several cases. Two representative shelves of one case are here shown

the story of the growth of the individual bird within the egg, the history of the development of birds from their reptile-like ancestors, such as *Archæopteryx*, and should illustrate the structure of the more characteristic features of the bird, like the wing, foot, and bill, and the growth and structure of feathers, the bird's unique possession.

Smaller subjective groups should illustrate the relation between structure and habit, showing, for example, how a certain type of bill—that of the humming bird, hawk, or heron—is used to secure food. Changes in color with age, sex, season, and climate may be illustrated; the manner in which they are accomplished should also form the subject of small groups.

Groups showing the food of birds and their economic value to man as destroyers of insects and rodents, and as devourers of the seeds of weeds should be given special prominence, and they may be supplemented by others illustrating some of the results of artificial selection in developing breeds of fowls and pigeons from the wild ancestral type.

There should be maps to illustrate the distribution and migration of birds, and photographs from nature showing the birds in their haunts. Specimens mounted with wings spread or in special poses should serve as models for artists, sculptors, and illustrators.

The eggs of local birds may be shown in their nests, but the facts to be learned from a study of birds' eggs may best be illustrated by a synoptic or subjective collection. Exhibits should not only be scientifically accurate and informing but artistically pleasing, and designed to arouse and hold the attention of the visitor. They should, of course, be adequately labeled, and so far as language and typography permit, the label should be as attractive as the exhibit.

Neither exhibits nor labels, however, can tell the whole story of bird-life. The duty that a museum department of birds owes to the public does not, therefore, end in its exhibition halls. The departmental staff should be prepared to meet all calls for information regarding birds and bird-life. Such requests may come from beginners in bird study or from professional ornithologists; from artists, authors, explorers, sportsmen, or game protectors, and may cover every known and many unknown phases of the subject, but so far as possible, each inquirer should be given the information he seeks.

The above is an outline merely of the functions of a museum bird department. Its measure of success in performing them will depend primarily upon the character and size of its staff. Before speaking of the collections of the American Museum it will be well, therefore, to say a word or two about those who are in charge of them. The duties of the staff, in the field and in the study, will appear as the history of the departmer is recorded.

PERSONNEL OF THE DEPARTMENT

One can conceive of a department of birds with curators and without specimens, but the largest collection of birds without an ornithologist to study it or exhibit it would be as useless as the minerals of an unworked mine. In other words, live men are worth more than dead birds.

There were specimens of birds in the American Museum in 1877, but there was no department of birds until Dr. J. A. Allen was called from the Museum of Comparative Zoölogy to form one in 1885. Prior to this time the trustees had availed themselves of the expert services of Dr. Daniel G. Elliot to purchase mounted birds in Paris, and Robert Ridgway had been employed to name them. Dr. E. A. Mearns and Dr. A. K. Fisher worked as volunteers for a brief period in cataloguing specimens, and Mr. H. B. Bailey performed a like task with the collection of eggs that had been purchased from him. But the department of birds did not actually come into existence until Doctor Allen was appointed its first curator on May 1, 1885. At that time it was known as the department of mammalogy and ornithology.

Nearly three years later, March 1, 1888, the writer was appointed Doctor Allen's assistant and the virtual separation of the department of birds, as an independent division, occurred with the promotion of the writer to the rank of curator in 1908. In 1904 Waldron DeWitt Miller joined the staff, and he was followed in 1906 by Robert Cushman Murphy, who left in 1907 to enter Brown University, and, after serving as curator of the department of natural sciences in the Brooklyn Museum, returned to our department of birds in 1921. In 1907 James P. Chapin became our representative on the Congo Expedition, but his actual addition to our scientific staff was not made until his return from Africa in 1914. In 1913, Charles H. Rogers entered the department, resigning in 1920 to become curator of the Museum of Princeton University, his Alma Mater. His post in charge of exhibition collections is now filled by Ludlow Griscom, who has been with us since 1917.

This is obviously not the place to comment on the Museum's equipment in the personnel of its department of birds, but at least it may be said that four of its members are among the fifty Fellows of the American Ornithologists' Union. A list of the members of the staff with the year in which each one entered the employ of the Museum is appended:

1888 Frank M. Chapman, curator.

1920 Robert Cushman Murphy, associate curator, in charge of marine ornithology.

1903 Waldron DeWitt Miller, associate curator, in charge of North American ornithology, structural and systematic problems.

1907 James P. Chapin, assistant curator in charge of Old World ornithology.

1917 Ludlow Griscom, assistant curator in charge of Middle American and local ornithology.

1921 Jonathan Dwight, research associate in North American ornithology.

1918 Mrs. E. M. B. Reichenberger, research assistant in Neotropical ornithology.

1908 Mrs. Alice K. Fraser, secretary, in charge of files and records.

1921 Mrs. E. B. Bardwell, secretary.

1917 Joseph Zuckerman, clerk.

THE RESEARCH COLLECTIONS

Collections are acquired by purchase, by exchange, by gift, and through expeditions.

Research or study collections, composed of unmounted birds' skins, are the tools of the ornithologist. Mounted birds cannot be examined satisfactorily, and when exposed to light, their color often changes so materially that their scientific value is largely impaired. The technical studies of the ornithologist are, therefore, made with birds' skins, which are kept in light-tight, moth-proof cabinets. He also requires skeletons and specimens preserved in alcohol or in formalin.

For the purposes of exhibition a pair of each species is often sufficient, but for study each species should be represented by a series of specimens showing (a) its variations with age from the time it leaves the egg until it is fully mature; (b) its sexual variations; (c) its seasonal variations, showing the changes in color which may occur throughout the year, the molts and other processes by which they are accomplished; (d) its distribution; (e) its changes in color, size, or form with locality. Birds are often exceedingly responsive to the influences of their environment, and a study of their characters in relation to the conditions (chiefly climatic) under which they live have thrown much light on the factors affecting the more recent phases of their evolution.

A study of the migrations and the distribution of birds must be based in part on specimens, the examination of which eliminates the probability of misidentification and places records of occurrence on a firm scientific foundation. A large and carefully selected series of specimens of a species is required to enable the ornithologist to study its characters and their variations with age, sex, season, and environment, its migrations and distribution. The value of a study collection is determined, accordingly, not so much by its size as by the care that has been exercised in securing specimens to illustrate fully a bird's structure, color, and life history. Only when a museum is in possession of adequate research collections can its curators properly fulfil their functions in planning exhibits, in supplying information, and in advancing the science of ornithology.

When Doctor Allen came to the Museum, there was only the nucleus of a study collection of birds, and in response to his urgent recommendation the trustees purchased the historic Lawrence collection of 8000 specimens in 1887, which laid the foundation of our present splendid research series. Additional purchases were the Scott collection, 2400 specimens from Arizona in 1886, the Herbert Smith collections, 6000 specimens from Matto Grosso, Brazil, and 3000 specimens from Santa Marta, Colombia, in 1899, the Sennett collection, 9000 specimens, in 1904, and the Richardson Nicaragua collection, 3000 specimens, in 1908.

Meanwhile Dr. Daniel G. Elliot had presented to the Museum the collection of 2000 humming birds on which his monograph of this family had been based and Dr. E. A. Mearns had contributed a beautifully prepared collection of 5000 specimens from Arizona and Minnesota; in 1895, through the Linnæan Society of New York City, we received the Dutcher collection of 2500, chiefly Long Island birds; and in 1920 Mr. Frederick F. Brewster presented us with 2000 land birds collected for him by Mr. R. H. Beck in South America, including a number of species new to science and many new to the Museum.

While it is clear, therefore, that study collections of great scientific value may be acquired by gift and purchase, 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.

The explorations of the department began two years after its formation, and have covered a large part of the world. Their record is presented here in barest outline.

EXPLORATIONS OF THE DEPARTMENT

(THE NUMBERS ASSIGNED TO THE EXPEDITIONS CORRESPOND WITH THOSE ON THE MAP, P. 312)

(1) 1887	Montana: D. G. Elliot, Jenness Richardson. Mammals and birds.
(2) 1889	Florida: F. M. Chapman. Birds and mammals.
(3) 1889	British Columbia: C. P. Streator. Birds and mammals.
(4) 1890	Florida: F. M. Chapman. Birds and mammals.
(5) 1890–1	Northern Mexico: Lumholtz Expedition. F. Robinette. Birds and mammals.
(6) 1891	Florida; Southeastern Texas: F. M. Chapman. Birds and mammals.
(7) 1892	Cuba: F. M. Chapman. Birds and mammals.
(8) 1892	Colorado; Utah: C. P. Rowley. Birds and mammals.
(9) 1893	New Brunswick: J. Rowley. Mammals and birds.
(10) 1893	Trinidad, B. W. I.: F. M. Chapman. Birds and mammals.
(11) 1894	Dominica, W. I.; Trinidad, B. W. I.: F. M. Chapman. Birds and mammals.
(12) 1895	Greenland: Peary Relief Expedition. L. L. Dyche, Travis, J. D. Figgins. Mammals and birds.
(13) 1895	Kansas; South Dakota: W. W. Granger. Birds and mammals.
(14) 1896	Yucatan and Eastern Mexico: F. M. Chapman. Birds and mammals.

ORNITHOLOGICAL EXPEDITIONS IN THE WESTERN HEMISPHERE

The extent of territory in the New World covered by the expeditions sent out by the department of birds, American Museum, either unassisted or in coöperation with other departments of the Museum or with other institutions, is indicated in this map. The expeditions are arranged in chronological order, the numbers on the map corresponding with those in the accompanying table. A map of the world would, however, be required to indicate all of the regions explored ornithologically by the department. Bird collecting in the interests of the department is, for instance, now in progress throughout Polynesia and in Australia as well as in other localities of the Old World

(15) 1897 Vera Cruz, Mexico: F. M. Chapman. Birds and mammals.

(16) 1897 Alaska and Arctic Coast: A. F. Stone. Birds and mammals.

(17) 1898 Florida: F. M. Chapman. Birds. Gulf of St. Lawrence: F. M. Chapman. Bird Rock Group.

(18) 1900–1 Southern Mexico: A. E. Colburn. Birds and mammals.

(19) 1900 Florida: F. M. Chapman. Birds.

(20) 1901 Eastern Siberia: N. G. Buxton. Birds and mammals.

(21) 1901 Manitoba, British Columbia: F. M. Chapman. Small bird groups.

(22) 1901–3 Alaska; British Columbia: A. J. Stone, J. D. Figgins. Birds and mammals.

(23) 1903 California: Los Baños and Cormorant Habitat Groups. F. M. Chapman, J. Rowley, Carlos Hittell.

(24) 1903–6 Mexico: J. H. Batty. Birds and mammals.

(25) 1904 Florida: Sandhill Crane Group; Bahamas; Flamingo Group. F. M. Chapman.

(26) 1905 Florida: Water Turkey; Ward's Heron Groups. F. M. Chapman.

(27) 1906 British East Africa: Tjader Expedition. H. Lang. Mammals and birds.

(28) 1906 Nebraska: Prairie Chicken Group. Arizona: Desert Group. Wyoming: Golden Eagle Group. California: Condor Group. Oregon: Klamath Lake Group. F. M. Chapman, J. D. Figgins, R. Bruce Horsfall, Carlos Hittell.

(29) 1907 Bahamas: Booby-Frigate Bird Group. South Carolina: White Egret Group. British Columbia: Canadian Rockies Group. F. M. Chapman, R. Bruce Horsfall, L. A. Fuertes.

(30) 1908 Alaska and Northwest Territory: R. M. Anderson. Birds and mammals.

(31) 1908 Florida: Cuthbert Rookery Group. F. M. Chapman, L. A. Fuertes.

(32) 1907–14 Belgian Congo, Africa: Herbert Lang, J. P. Chapin. Birds and mammals, and other branches.

(33) 1910 Yucatan, Vera Cruz, Mexico: Orizaba Group. F. M. Chapman, L. A. Fuertes.

(34) 1911 Lower California: C. H. Townsend, H. E. Anthony, P. I. Osborn. Birds and mammals.

(35) 1911 Colombia, Cauca Valley region: F. M. Chapman, L. A. Fuertes, W. B. Richardson, L. E. Miller. Birds and mammals.

(36) 1911–12 Korea: Roy C. Andrews. Mammals and birds.

(37) 1912 Southern Colombia: L. E. Miller, A. A. Allen. Birds and mammals.

(38) 1912–13 South Georgia, Subantarctic Atlantic: Robert Cushman Murphy. (Jointly with the Brooklyn Museum.) Birds and mammals.

(39) 1913 Colombia, Bogotá region: F. M. Chapman, L. A. Fuertes, G. K. Cherrie. Birds and mammals.

(40) 1913 Western and Southern Ecuador: W. B. Richardson. Birds and mammals.

(41) 1913 Venezuela; British Guiana: L. E. Miller. Birds and mammals.

(42) 1913–14 Southern Brazil (Roosevelt Expedition): G. K. Cherrie, L. E. Miller. Birds and mammals.

(43) 1913–17 South America; West Indies: R. H. Beck. Birds.

(44) 1914 Northwestern Colombia: L. E. Miller, Howarth Boyle.

(45) 1914–15 Panama: H. E. Anthony; David Ball, W. B. Richardson. Birds and mammals.

(46) 1914–17 Greenland: Crocker Land Expedition. W. E. Ekblaw. Birds.

(47) 1915 Northwestern Colombia; Bolivia: L. E. Miller, Howarth Boyle. Birds and mammals.

(48) 1916 Bolivia; Northwestern Argentina: L. E. Miller, Howarth Boyle. Birds and mammals.

(49) 1916 Porto Rico: N. Y. Academy of Sciences Survey. H. E. Anthony. Birds and mammals.

(50) 1916 Urubamba Valley, Peru; Organ Mts., Brazil: F. M. Chapman. Reconnaissance, Ecuador, Bolivia, Chile, Argentina. Birds.

(51) 1916–17 Province of Yunnan, China: Roy C. Andrews. Mammals and birds.

(52) 1916–17 Southern Brazil: George K. Cherrie. Birds.

(53) 1917 Nicaragua: W. DeW. Miller, Ludlow Griscom, W. B. Richardson. Birds.

(54) 1918 Northern Venezuela: G. K. Cherrie. Birds.

(55) 1919–20 Coast of Peru (Jointly with Brooklyn Museum): Robert Cushman Murphy. Birds, fishes, etc.

(56) 1919–20 Jamaica: H. E. Anthony. Birds and mammals.

(57) 1920–21 Southern Ecuador: H. E. Anthony, George K. Cherrie. Mammals and birds.

(58) 1920 Central Polynesia: R. H. Beck, E. H. Quayle. Birds.

(59) 1921 Southern Ecuador: George K. Cherrie; G. Gill; H. H. Tate. Birds and mammals.

(60) 1921 China: Roy C. Andrews. Mammals and birds.

(61) 1921 Australia: H. C. Raven. Mammals and birds.

(62) 1921 Azores: J. G. Correia. Birds.

(63) 1921 Southeastern Brazil: E. G. Holt. Birds.

The collections acquired through these expeditions include, of course, many duplicate specimens, which, after they have been studied, are exchanged with other museums for species inadequately or not at all represented in our collection.

In this manner the department secures much material that is valuable scientifically and historically. For example, the curator of the department during a recent visit to England secured by exchange with the British Museum and Lord Rothschild's museum at Tring, no less than 136 species not heretofore represented in our South American collections.

Finally, the working value of our research collections is enormously increased by the deposit in the Museum of the private collections of Dr. Jonathan Dwight, Dr. L. C. Sanford, and Mr. Frederick F. Brewster, which form as much a part of our scientific equipment as do the specimens contained in our own collections.

EXHIBITION COLLECTIONS

The character of a museum's exhibits in any branch of natural history will reflect the attainments of its scientific staff, the opportunities they have had for research, and their interest in presenting the known facts of their subject to the public. The degree of accuracy shown in the identification of specimens, the amount of skill manifested in arranging them to illustrate their structure, relationships, distribution, and habits, the success attending the planning and preparation of special groups, are expressions of the curator's experience and knowledge as well as of his ability to understand the public's point of view.

When the Museum was established, the trustees, represented by Dr. D. G. Elliot, purchased from Verreaux Frères, natural history dealers in Paris, a notable collection of 6000 mounted birds, representing most of the known types. Dr. Elliot, still acting for the trustees, also bought the mounted collection of Prince Maximilian of Wied, consisting chiefly of Brazilian birds collected by that explorer. The two combined, with the collection presented by Dr. Elliot, the Sanford collection of North American water birds, deposited by Dr. L. C. Sanford in 1910, and the collection of birds of paradise presented by Mrs. Sturges in 1905, form the greater part of the general exhibition collection of the department. From time to time previously unrepresented species have been added until the total is now about 12,300 specimens.

These birds are placed in two collections: first, a synoptic collection of the birds of the world; second, a faunal collection. The synoptic collection permits the student to compare the African ostrich with the South American rhea, for example; the faunal collection enables him to gain some conception of the general character of the bird life of the major zoölogical realms.

With the establishment of a department of preparation in 1886 under Jenness Richardson, the Museum made its first attempt to present bird exhibits other than those of specimens on T-perches, by the preparation of what is known as "accessory groups." These groups show the bird with its nest *in situ* and its immediate surroundings. The earlier groups in this series (robin, wood thrush, etc.) were prepared by Mrs. E. S. Mogridge, and her brother, Mr. Minturn, who had made similar exhibits for the natural history branch of the British Museum in Cromwell Road, and from them the members of our staff learned the art of making artificial vegetation. The groups in this series now represent all of our more common and some of our rarer breeding birds, some from the western states, and a number of interesting foreign species, like the hornbill of Africa and the ani of tropical America.

A further departure from current museum methods was the installation in 1894 of a local bird collection, containing only the species found within fifty miles of New York City. This includes both a systematic and a seasonal series, the first containing all the local birds, the second only those of the month (page 308). As the birds come and go in their migrations, they are added to or taken from this seasonal collection, which, therefore, not only gives one at a glance a picture of the bird-life of the moment, as it were, but, by elimination, enables the local student to look for a specimen of some species he has recently seen near New York among a few score birds rather than among 12,000.

The group showing almost in facsimile a portion of the historic Bird Rock in the Gulf of St. Lawrence was made in 1898 and marks the transition between the accessory group and the habitat group, with its panoramic background. The first habitat group, showing the bird-life of the beach on Cobbs Island, Virginia, was made in 1902, and with the support of a number of friends of the Museum, led by the late John L. Cadwalader, the series was added to during the succeeding ten years until the hall assigned to it was filled.

Habitat groups are based on original field studies by ornithologist, artist, and preparator. The backgrounds, painted by R. Bruce Horsfall, Carlos Hittell, Hobart Nichols, Carl Rungius, and Walter B. Cox, with birds by Louis A. Fuertes and R. Bruce Horsfall, are realistic productions of definite localities, and thus in themselves possess a scientific value, as they depict not only the home of the bird shown with them, but characteristic American scenery from the Atlantic to the Pacific, from the table-land of Mexico to the barren grounds within the Arctic Circle. Habitat groups established a new standard in the exhibition of birds and they constitute one of the Museum's most important contributions to methods in this field.

At intervals special groups have been prepared to illustrate certain facts in bird-life; for example, the development of the chick, protective coloration, geographic variation, methods of securing food, habit, structure, etc. This series may be indefinitely expanded, but lack of space has forced the department to abandon for the present its elaborate schemes for the development of its exhibition collections. We want especially to illustrate the economic relations of birds through the nature of the food they consume, the flight of birds, and the more significant facts of their evolution; but until the erection of a new building permits the removal of the exhibits of other departments from our halls, we can make no progress with our plans.

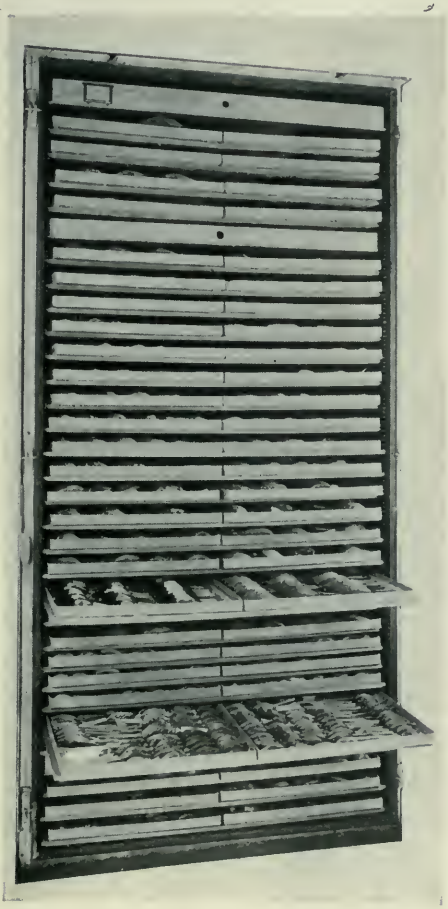
The subject of exhibition collections should not be left without a word in regard to our relations with the department of preparation. While in museum organization such a department is usually a distinct unit, it is so closely connected with the departments it serves that it becomes, in effect, a part of them. Certainly the department of birds owes much to the coöperation of the department of preparation for its share in the mounting of the exhibition collections; and it is well to record here our indebtedness to Jenness Richardson (1886–91), John Rowley (1892–1904), J. D. Figgins (1897–1910), Ernest W. Smith (1916–17), H. C. Denslow (1901–2), and their assistants. To their skill and artistic ability we must attribute the success which has attended our efforts to bring the bird and its haunts into our exhibition halls.

THE RESULTS OF RESEARCH

The principal, if not the sole, duty of the ornithologist is commonly believed to consist of "stuffing birds," but it has been shown, I hope, that something more than a knowledge of taxidermy is required to plan and successfully develop exhibition collections that will illustrate the bird's place in nature and the known facts of its history.

The efforts of the Museum's ornithological staff, however, are not exclusively devoted to the arrangement of exhibits. Let us, therefore, visit the laboratories of the department of birds and learn what are the actual duties of the professional ornithologist.

The building up of a well-rounded collection of specimens, with certain definite



The study collections of the department of birds, American Museum, are arranged in trays that fit into fireproof steel storage cases of this type

objects in view, calls for a knowledge of geography, as well as of the needs of ornithology. At present the bird department has expeditions in Ecuador, Peru, Polynesia, Australia, Cape Verde Islands, and China. Before they took the field the problems in mind were carefully considered, and by as frequent communication as circumstances permit their work is being directed by the member of the staff concerned. When the specimens finally arrive at the Museum in the shape of study "skins," which look very much like dead birds, they must be catalogued and named. To be prepared to name any one of the 18,000 or more different species and subspecies of birds found in the world and to give new names to those which have not before been described, requires so special a training and so wide a knowledge of the vast literature of ornithology that it forms a distinct branch of the study of birds, and the expert skilled in the practices of classification is known as a systematic ornithologist, or systematist. Whatever be the bird student's special field, his work must be preceded by this naming of the specimens, the "giving of a handle" to the fact of their identity. This accomplished, he may direct his attention to any one of the numberless problems which confront the student of bird-life.

Birds are not only "eloquent expressions of nature's beauty, joy, and freedom," but also of the workings of natural laws; and study of them has contributed in no small degree to our knowledge of the laws governing the evolution and distribution of life. Through the intensive studies of the ornithologist, much definite information has been acquired of the relation between a bird's color characters and the climatic conditions under which it lives, and these discoveries have an important bearing on the evolution of species by environment. A study of the distribution of birds based on large and carefully identified collections has assisted the zoögeographer in mapping the boundaries of natural life areas, in determining past continental relations, and the origin of the altitudinal zones of life found on higher mountain ranges. A study of the remarkable journeys made by birds in traveling between their winter and their summer homes, of their architectural instincts, and of all the

The exhibit of song sparrows in the American Museum illustrates their variation in size and color in response to the influences of environment.

Note that the smallest race or subspecies (*Melospiza melodia mexicana*) is found at the most southern part, the largest (*Melospiza melodia kenaiensis*) at the most northern part of the range of the species; also that the palest colored race (*Melospiza melodia fallax* of the Colorado Desert) is found in the most arid region, while the darkest colored race (*Melospiza melodia cinerea* of the Northwest Coast) inhabits the most humid region. Twenty-odd races of song sparrows are known, all of which are believed to intergrade with their neighbors as the climatic conditions of the areas they inhabit merge with those of adjoining areas

other phenomena of the nesting season, must also be preceded by the identification of the species concerned.

Further idea of the nature of the researches of the professional ornithologist may be gained from the long list of published works by the members of our staff. To the reader who believes in the value only of applied science, it may be said that these written records of our work form a portion of the framework which supports the visible structure of ornithology as he sees it in our exhibition halls or in the many popular works which have helped to make birds a part of our lives. Ultimate results are not gained in a step, and much labor is often required before a theory becomes a fact.

THE BIRD DEPARTMENT AS A BUREAU OF INFORMATION

By no means all the curator's time is given to research in field and study, or to the planning of exhibits and the supervising of their preparation. The store of information which he has gathered is made available to the public, not only through exhibitions and publications, but by interviews and correspondence. There are days when an unending stream of visitors comes to the department of birds in search of information concerning birds, or in regard to the countries in which it is known that members of our staff have explored—and this includes the greater part of the earth's surface. A further and very heavy drain upon our time is made in replying to thousands of letters which are received yearly. Add to this the preparation and delivery of lectures upon the results of our work in the field and in the laboratory, and it will be seen that the department is a bureau of ornithological information.

Without mentioning the part taken by members of the department staff in the proceedings of scientific societies, in the work of various organizations designed to promote the protection and study of birds, and in coöperating in a variety of ways with their colleagues throughout the world, it is hoped that this brief review of the more important activities of the department shows that, to some extent at least, it has attained the objects for which it was formed. If we are still far from reaching the standards toward which we aim, we trust that the construction of a new building, with the resulting increased space in exhibition halls and laboratories, will add greatly to the number, beauty, and instructiveness of our exhibits, to the value of our scientific work, and to the effectiveness of our services to the public.

A NEW BOOK ON LONG ISLAND

The Evolution of Long Island—A Story of Land and Sea, by Professor R. H. Gabriel of Yale, has recently been issued by the Yale University Press.

Taking Long Island as a unit of space which has for long ages been on the border line between land and sea, Professor Gabriel shows clearly how human development in the region has been controlled very largely by the same cosmic circumstances responsible for the type of vegetation and native animal life.

Beginning with an account of the geologic and climatic setting, the author sketches in successive chapters the struggle for existence from the first settlement of the eastern end of the island by pioneers from New England, and their gradual spread westward until they came into contact with the Dutch settlers at the end nearest New York. The author then carries us through the slow and painful changes in agricultural methods, caused by the influence of the hinterland and the growth of the great metropolis just beyond the western end of Long Island; and then, one after another, he describes the various trades and callings which have drawn the youth of the region toward or away from the sea. Whaling voyages, the era of menhaden fishing with its growing coöperation which ended in monopoly, the progress of the oyster fisheries with its increasing complexity, the clam and scallop industries, piracy, smuggling, ship-building, etc., are all treated in turn. Chapters of great interest are devoted to the inception and development of the Long Island Railroad system and to the construction of modern roads, which have made the territory everywhere penetrable both to industry and to pleasure seekers, and which have been coincident with what Professor Gabriel calls the "discovery of the out-of-doors."

The varied geographical character of Long Island, with its exceptionally long shore line facing on both ocean and inland sound, its lagoons and broad meadows, its glaciated and forested northern shore and its extensive "pine barrens," makes it a peculiarly interesting region for a broad philosophical study such as Professor Gabriel has prepared, and his work is a notable contribution to history of the new type. His problem has been to trace the development of a people as it has been affected not by its social and economic conditions but by its *natural surroundings*.

—R. C. M.

FROM A PORTRAIT IN RELIEF OF THE ILLUSTRIOUS FRENCH ENTOMOLOGIST
By T. Spicer Simson

A PILGRIMAGE TO THE HOME OF FABRE

BY

L. O. HOWARD*

PROBABLY no writer on natural history topics has ever had a larger audience than Jean Henri Fabre, the illustrious Frenchman who died at Serignan in 1915. His books have been translated into many languages and, since his death especially, have had an enormous vogue in the United States; so that I am probably safe in supposing that in preparing this article I am adressing people who know his writings and love them.

My own attitude toward the close observer and charming writer may be gathered from the fact that I have called the visit which I made to Harmas in 1920 a "pilgrimage," a word which has come to have an especial meaning which includes the idea of reverence.

In June, 1920, I was in the south of France, in company with the famous entomologist, Dr. Paul Marchal of Paris, and his assistant, Mr. P. Vayssière, engaged in watching the operations then going on against the Moroccan locust, a very interesting experience for me, since French soldiers had been loaned to the organization of farmers to help in the fight and they were using army flame-throwers against the grasshoppers with much success. One night we were sitting in the hotel at Arles (the former home of Mistral, the famous Provençal poet), looking over the maps of the region, and my eye caught the name "Serignan"; whereupon I proposed that we visit the old home of Fabre provided our next day's route should take us in

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that general direction. So the next morning we started out in a Ford of the model of 1913, which had served through

Photograph by L. O. Howard
Demoiselle Fabre, the daughter of the "Insect Homer," in the garden at "Harmas"

the war and had been placed at our disposal by the French government. We passed through Tarascon and a number of smaller villages for a distance of about ninety kilometers, reaching the village of Serignan about eleven o'clock. The country was charming, rolling in character, with densely shaded roads, lined for the most part with *Platanus* trees and in some places with poplars. Wheat, oats, grapes, and olive orchards bordered the road.

As it happened, Vayssière's grandmother lived in the neighborhood, and his father had lived there and had been a personal friend of Fabre; so that our companion knew the country well.

Serignan is a typical south of France village, with nothing that especially distinguishes it from many others. It is not on the railroad, the nearest station being Orange, about seven miles away. Passing through the main street of the little town, we deviated at a slight angle into a narrower street of little shops and stone houses, and it was interesting to note on the signpost that it was known as the Street of Henri Fabre (*Rue de Henri Fabre*). I think that it is the only street in the world named after an entomologist. A short distance farther on we came to the smaller villa district, and on a corner was apparently a rather large estate surrounded by a very high wall. We dismounted, rang the bell at the gate, and presently heard slow, approaching footsteps. The gate was opened by a little, old, bent, gray-haired woman, apparently between sixty and seventy years of age, whom Vayssière addressed as Demoiselle Fabre; and he was recognized in turn when he mentioned his name. He introduced Marchal and myself, and the introduction was acknowledged very quietly without a smile or without any especial cordiality, as though it were a quite-to-be-expected thing that eminent scientific Frenchmen and foreign men of science should call to see her father's house.

Although Demoiselle Fabre is very small, her father was a tall man, which is contrary to the impression one gains

Photograph by L. O. Howard

FRONT VIEW OF FABRE'S HOUSE

On acquiring this property after years of hard work and self-denial, Fabre referred to it as Eden, for to the bees and the wasps it was "an earthly paradise" and hence no less so to the entomologist

Photograph by L. O. Howard

A DETAIL OF FABRE'S HOUSE

Glancing up to the second story, one sees one of the heavily-shuttered windows of the workroom, which enshrines mementos innumerable of Fabre's activities from the pictures which have been published in this country and England, for the latter were taken when he was very old, emaciated, and bent, and all show him seated.

Demoiselle Fabre asked us to step inside, and Vayssière told her we should like to see the house and the garden and the laboratory where Fabre worked during his later years. Contrary to the usual French custom, she made no effort to entertain us by offering a glass of wine, but showed us the stairway leading to Fabre's principal workroom and left us to do as we pleased.

The house is a good one, hardly beautiful, with a square principal portion two stories in height, and an L, also two stories but lower than the main building. The house is built of stone and covered with yellow plaster. The floors throughout are of wood and uncovered. The second story workroom is in the L and is about 15 by 20 feet in size. It is really a small museum, containing a collection of fossil shells in wall-cases placed on two sides and a herbarium on top of the wall-cases. In the middle of the room is a plain, eight-foot wooden table, with bell glasses and specimens of insects in differently shaped boxes, and some odd specimens of insect work. There is an open fireplace at one end of the room and an old desk in the corner. The room has two windows with panes painted white and heavy wooden shutters. Between the windows, which look out into the large garden, there are two shelves supporting cans, jars, and bottles, all containing specimens. On the desk were a few simple instruments—pinning forceps, a scalpel, some dissecting needles, and a primitive magnifying glass.

In the main part of the house, next to the broad hallway, was the darkened parlor, and on the walls were a dozen or more enlarged photographs and portraits of Fabre. Between the two windows on one side of this parlor was a large bookcase containing books on entomology as well as zoölogy in general and botany, and in this case were a number of different editions of Fabre's monumental work, *Souvenirs Entomologiques*. Demoiselle Fabre, who had rejoined us, called our attention with much pride to the illustrated, definitive edition published in 1914 by Delagrave, the illustrations of which, she told us, had been made largely by her brother, who assisted in the editing. She brought out a leather-bound visitors' book and asked us to register our names. She told us that Fabre had lived in this house for thirty-eight years.

The garden is a large one, covering, I should judge, somewhat less than an acre, and is almost a luxuriant jungle. Near the house is a pool made of masonry, in which grow aquatic plants; here Fabre studied his aquatic insects. The garden was originally planted with shrubs from all of the surrounding region, including some from the foothills of the Alps. I photographed the house from two points of view, and also took two snapshots of Demoiselle Fabre standing with or near Marchal and Vayssière. I also tried to take the pool and a garden view, but without success—the shade was dense, owing to the almost wild luxuriance of the vegetation. The gravel paths were kept comparatively free but, in passing through, one was brushed on both sides by branches.

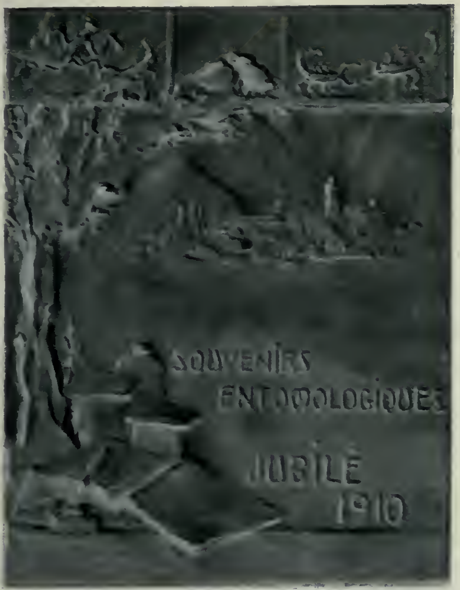
I had a very profound feeling all the while that I was an extremely fortunate person to be able to stand where Fabre had stood, to walk upon the ground he had traversed for so many years, to look upon the very cages and apparatus which he used in his ingenious experiments, to see flying about probably the descendants of some of the very bees he had studied, and I fully realized how much such an opportunity would be prized by hundreds of thousands of the readers of his books. I said something of this sort to my companions, and I was rather shocked to find that they did not entirely share my admiration for the great writer. I mentioned Professor Bouvier's eulogium published in the *Revue génèrale des Sciences pures et appliquées* in Paris, 1915, and they responded by asking me whether I knew the summary of Fabre's life and works by Ferton, published in the *Revue Scientifique* in September, 1916. I was aware that Fabre's theories had frequently been attacked and that he had made many critics by his pronounced anti-evolutionary views, but I did not know that his accuracy as an observer was subject to serious challenge. But these men told me that, while Fabre ranks among the great in France as a popularizer of science and as a writer of wonderful charm, he has made too many mistakes to be considered a scientific light of unblemished luster.

Since then I have read Ferton's account. Ferton himself died in 1921, in Corsica, where he had lived for the fifteen or more years prior to his death. He was a retired officer of artillery, and for many years has been adjudged the keenest and most careful student of the habits of bees and wasps, and especially of the instincts of these creatures, that France has produced. He was, therefore, entirely competent to criticize a large part of Fabre's work. I have often been asked my estimate of Fabre, but I have never made any studies of the especial insects the lives of which he has immortalized, and I have always been inclined to accept the popular judgment of the man. In fact, aside from Ferton's article, everything that has been written about Fabre since his death has been panegyrical. No word of criticism seems to have been uttered. Perhaps this is hardly fair to his numerous readers and admirers. At all events, let us look at him for a moment through the truthful, trained, and thoroughly scientific eyes of Ferton, who states distinctly that Fabre had his weak side and that his published works have shown a trace of this side. He says: "It is our duty to show our great men just as they were. Their fame will not be diminished by this; and Fabre, in spite of his errors, will remain the great Fabre to whom we owe many beautiful and important discoveries, described in marvelous and enthusiastic language. It is with this thought that I allow myself to make certain criticisms."

By far the greater part of Ferton's long essay is appreciative. He analyzes Fabre's character; he dwells at length upon many of his most interesting researches, and praises to an extreme the charm of his literary style. He charges him, however, with ignorance of, or non-acknowledgment of, the work of others; with carelessness as to the true identity of the species with which he worked; and with faulty observation or incorrect statement concerning one or more of the species that he studied. In each of these charges he brings forward his evidence in a rather conclusive way, but we have no space in this article to give his details. Although praising Fabre's charming literary style, he nevertheless charges him with undue redundancy, and, in at least one instance, with imagining an incident that could never have occurred. He insists that Fabre's bitter complaints about the material difficulties of life and his accusations against society were unjustified, and that he had a comfortable income for very many years, his chronic impecuniosity coming from his indifference to domestic economy.

This, summarily, is the gist of Ferton's criticism, which, however, is not given in this bald way. His review as a whole is highly appreciative and in no way lessens Wheeler's estimate of Fabre as the discoverer of the great significance of animal behavior and of the value of the experimental method in the investigation of the animal mind.

Nowhere have I seen a more just or more enlightened view of Fabre's work than that given by Wheeler in his introduction to *Wasp Studies Afield*, by Philip and Nellie M. Rau, issued by the Princeton University Press in 1918. In Wheeler's opinion, Fabre, Latreille, and Réamur are the three greatest entomol-



THE FABRE JUBILEE MEDAL STRUCK IN 1910
Obverse and reverse sides
Photographed by J. G. Pratt from the medal in the possession of the author

ogists, and he believes that in Fabre's writings we must acknowledge certain preconceptions which really strengthen their merit and beauty. Wheeler's idea is that Fabre's training as a physicist, chemist, and mathematician made him desire to establish clean-cut laws. In view of this, and because of his scholastic conception of instinct, he insisted on the normal course of behavior in insects; he ignored the variations, and, as a result, "his descriptions and discussions leave an impress of elegance and finality like a demonstration in mathematics or physics." Wheeler points out also that when *The Origin of Species* was published, Fabre was too old and too set in his ways of thinking to acquire any sympathy with evolutionary theories. Bearing these things in mind, the value of his work is easy to estimate: "He is indeed so preëminent in the wealth and precision of his observations, in the ingenuity of his experimentation, and in literary expression, that his *Souvenirs* will always endure."

Nests of this general character are the unaided production of the female mud dauber wasp, the name commonly applied to two genera of similar habits, *Sceliphron* and *Chalybion*. Each cell of the nest is stocked by the female with captured spiders that she has stung and paralyzed. When the grub emerges from the egg that the parent has laid before sealing up the cell, there is plenty of fresh food available. The cells here shown have been uncovered to reveal the contents. Left to their own devices, the insects would not have issued from these cells until they had reached the adult stage

A mud dauber wasp. *Sceliphron cementarium*, and her ball of mud, one-fourth inch in diameter. The ball is many times the size of the insect's head, yet she fashions it rapidly, working in muddy or moist ground and having as her tools only her mouth parts, assisted in the later stages by her fore legs

WASPS THAT HUNT SPIDERS

OBSERVATIONS ON *SCELIPHRON* AND *CHALYBION*

BY

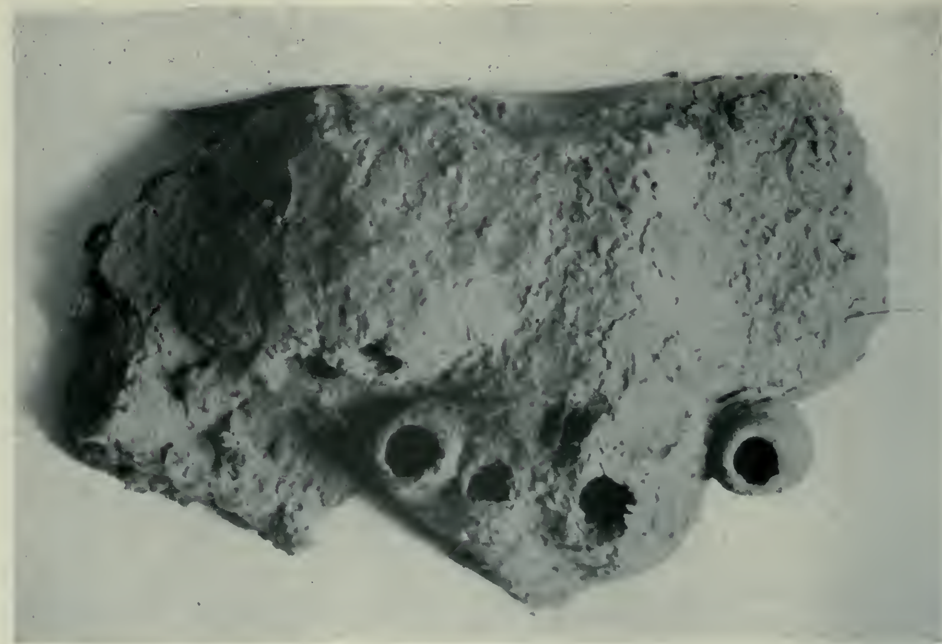
WILLIAM M. SAVIN*

ALTHOUGH young bees are fed with nectar and pollen, the larvæ of wasps are given food of grosser character, consisting, according to the provisioning species, of insects of different orders and even spiders. The big *Pepsis* of the Southwest is popularly known as the "tarantula killer," and well does she deserve her name, for she attacks and usually gains the mastery of a creature that man views with dread. Other members of the family Psammocharidæ, to which this wasp belongs, are also spider-destroyers. It might be thought, therefore, that spiders are the preëmpted diet of a single family of wasps, but that is not the case. The wasps described in the article that follows belong not to the Psammocharidæ but to the family Sphecidæ, a family of contrasted dietary habits, for certain other genera of this family provision their nests respectively with crickets, grasshoppers, and caterpillars.
—EDITOR.

AMONG the solitary wasps, of which there are a great many different kinds, the mud daubers, *Sceliphron* and *Chalybion*, seem to me especially interesting subjects for observation. Nests of these wasps have been found plastered "to nails protruding from the walls, on umbrella ribs, cornhusks and other unlikely places," not to mention vines and the root of an overturned tree. The lower surfaces of flat stones are also used. Before the arrival of man points of attachment supplied by nature must have been employed exclusively. Today, however, the nests of mud built by these wasps are frequently found in sheltered places about buildings, stocked with spiders which the mother wasp has stung and paralyzed as food for the larva that will later emerge from the egg that she lays.

Both *Sceliphron* and *Chalybion* construct a number of tubular cells in making their nests, which are generally placed in a vertical or horizontal position. The female wasp gathers mud, which she forms into a ball having a diameter of about one-fourth of an inch, though

*Illustrations from photographs by the author



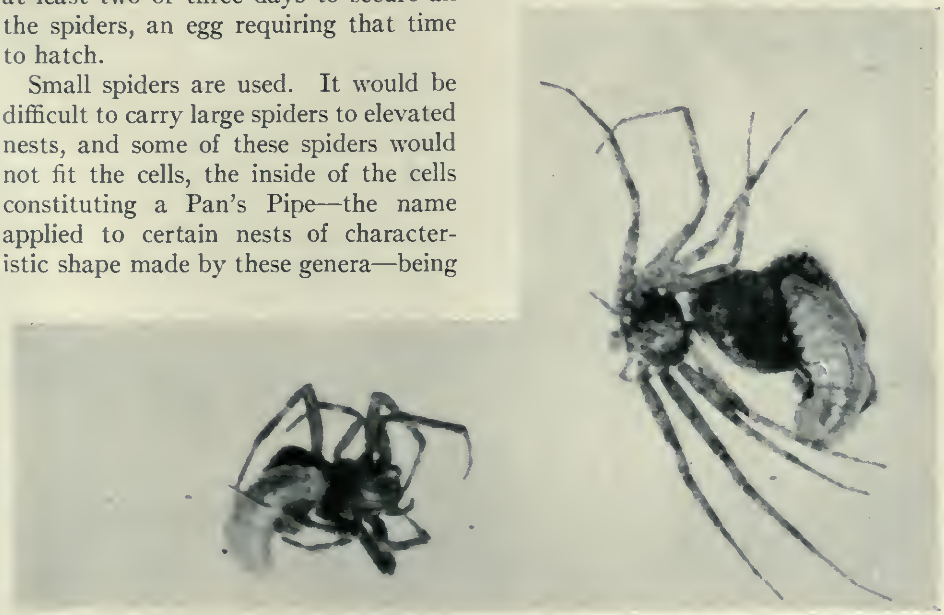
After the wasp larva has devoured its store of spiders, it undergoes a metamorphosis, emerging finally as a winged adult from the dark cell in which it has spent its babyhood and youth. The round holes give indication that the former tenants of the several cells have made their exit

In a nest of this type there are numerous cells, some of which are not visible, being covered by others built subsequently. This nest has been recently finished by the parent wasp. All the cells are sealed, and within them various happenings are taking place. In those last made, eggs are hatching, in others larvæ are devouring spiders, and in still others the insects are undergoing pupation preparatory to becoming adult wasps sometimes smaller, and with it flies to the nest site, where she applies it to the construction of the cell.

Stocking the cell with spiders is an arduous task and often requires two or more days for its completion. On many occasions after watching the stocking of a cell and then the sealing of it, I have immediately opened it and found a larva on one of the spiders deposited in the early stages of the provisioning—an observation which prompts the conclusion that the wasp had hunted at least two or three days to secure all the spiders, an egg requiring that time to hatch.

Small spiders are used. It would be difficult to carry large spiders to elevated nests, and some of these spiders would not fit the cells, the inside of the cells constituting a Pan's Pipe—the name applied to certain nests of characteristic shape made by these genera—being only about three-eighths of an inch in width. Even cells of smaller diameter are found.

Some spiders are so thoroughly paralyzed by the sting of the wasp at the time of their capture that they die soon afterward, if indeed they are not killed immediately by a too profuse injection of the poison. Others may be seen moving their legs slightly as the cell is opened. Even if they can show these faint evidences of life, however, they are normally doomed captives, entombed as they are in a sealed cell. The wasps do not confine themselves to any particular kind of spider, although they capture many more orb weavers than they do other types. They secure also a number of crab spiders (Thomisidæ) and occasionally a jumping spider (Attidæ). I have never found any Lycosidæ, wandering spiders, among the captures of the wasps, which may find difficulty in locating them among the grasses. Although the grass spider (*Agelena nævia*) is probably the most abundant spider in our fauna and many of them live in exposed places, I have never found one in a mud dauber's nest.



Two mud dauber larvæ, each attached to the abdomen of the spider that serves as food

The captured spiders are placed in the cell constructed by the wasp, and an egg is laid on one of them, after which the cell is sealed with mud. When the egg hatches, the larva disposes of the spiders in less than a fortnight, pupates, and emerges as an adult wasp.

Although it has been authoritatively stated that the egg is laid on the last spider placed in the cell, I have not found that to be the case in a number of the cells I have opened. As often, the egg

Nine spiders and a mud dauber larva were taken from one cell. Judging from the size of the larva, the cell must have contained originally additional spiders. Among the survivors are crab spiders and orb weavers, one of the latter being a male which may be identified by the bulbs on the pedipalps, leglike appendages near the mouth of the spider. From an examination of the spiders captured by the mud dauber wasps, it would seem that female spiders are more numerous than males—a question which has long been under discussion

had been placed on the first or on one of the first spiders deposited. In certain other instances it was discovered near the middle of the cell. This lack of system may account for the unusual condition of some of the cells: occasionally I have come upon a cell well stocked with spiders but devoid of an egg or emerged larva; in a few instances I have found in a cell two larvæ devouring the spiders, but one of these larvæ may have been that of a parasite.

Now and then the wasp appears to have been forgetful or shiftless, for I have occasionally found a cell without any provisions or larva in it. Another possible explanation is that such empty cells have been stripped of their provisions by *Sceliphron cementarium* which, according to my observations, at times robs the store gathered by wasps of her own species. On one occasion while watching a *cementarium* that was engaged in putting the finishing touches to her nest plastered on a rafter, I became conscious of another wasp of this species that had a nest on the other side of the board. This wasp went in and out of her cell and wandered several feet from it to inspect the nests of other wasps. After a short time she returned with a spider and deposited it in her nest. My main attention was still directed to the wasp that was closing her nest, and only

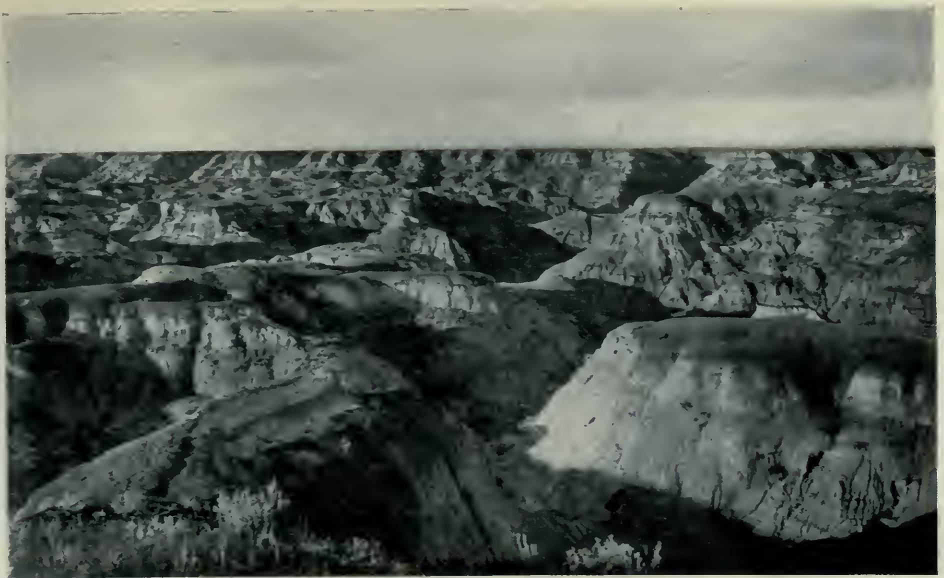
The number of spiders placed in a cell is variable. Sometimes the mother fails to gather sufficient food for the growth of her offspring. By way of contrast to such improvidence is the too-abundant provision indicated above, twenty-three spiders all from a single cell! One would judge that the hoard had been gathered for some prospective glutton of the insect world, but after all her efforts in capturing the spiders and packing them into the nest, the careless wasp mother neglected to lay an egg upon them

intermittently to the spider hunter. I was impressed, however, with the fact that the latter had secured a victim so speedily, and secretly commended her as an expert huntress, not suspecting that her capture was not legitimate game. Again she left her nest and in a moment returned with another spider, which, absorbed as I still was in watching the other wasp, I had not seen her secure. At this stage I began to surmise that she had not come by her spiders honestly. When she came out of her cell, I followed her to another nest about ten feet away. From it she brought a spider and carried it to her own. Three times thereafter she repeated this action and it is a fair inference, therefore, that she stole also the two spiders that I saw her place in her nest first. She soon sealed the cell. When I opened it, I found therein twelve spiders, four of which had certainly been stolen, two probably, and the remaining six possibly. An egg had been deposited on one of the early spiders placed in the cell.

On another occasion I was watching a *Sceliphron cementarium* that had made but one cell for her nest and was ready to stock it. For a time she wandered to and fro, then went to a nest near by, entered it, and brought out a spider, which she placed in her own cell. She again visited the nest she had robbed, but although there were other spiders available, she did not repeat her theft.

The owner of the despoiled nest returned shortly, entered her cell for a moment, and on coming out examined the exterior of the nest for several minutes. This wasp brought no spider on this visit. The cells of both nests were sealed up a little later, the mishap possibly hastening the action of the wasp that was robbed, for her nest was not fully stocked. Neither was that of the thief, however, for this wasp showed herself indolent as well as depraved. On opening her nest I found in it only one spider, a small female banded epeira (*Metargiope trifasciata*) with an egg on it. This scanty supply of food could not have enabled the emerging larva to survive long. That the egg was in all probability laid by the thief and had not been transferred by her from the other nest when she removed the spider is attested by the fact that in the despoiled nest an egg was found on one of the five spiders placed therein.

On several occasions I have experimented with the larvæ to test their efforts at self-preservation, and the instance described below is typical. Due to the character of the cells the larva is always in close touch with the food supply, which it can obtain with a minimum of effort. It was of interest to me to ascertain whether it would go in search of food more remotely placed. Upon seeing a *Chalybion cœruleum* seal a Pan's Pipe, I accordingly secured the nest and opened it. There were four compartments in a row, each cell being stocked with spiders. In one of the cells was an egg, which had been laid on the last spider deposited, in another a small larva, and in each of the remaining two a larva about half grown. I placed the three larvæ, each still attached to the spider on which it was feeding, in a large dish and then some inches away, in the same dish, the untouched spiders from the three cells in which these larvæ were found. The dish was then covered with a newspaper so as to exclude the air. The smallest of the larvæ lived only a couple of days, nor did other small larvæ which I used subsequently in similar experiments survive longer. One of the two large larvæ after completely consuming the spider on which it was feeding, worked its way across the dish to the heap of spiders and proceeded to devour one. The other large larva sucked only the juices from the abdomen of its spider, whereupon, leaving the enveloping skin of the abdomen as well as the untouched cephalothorax and legs, it too worked its way over to the large supply of spiders, which were apparently more inviting. Twice after that I placed the spiders at the opposite edge of the dish and in each instance the larvæ wriggled to them. The supply of spiders was increased through the addition thereto of those contained in the cell in which an egg was found. A larva had emerged from this egg after from two to three days but it had survived for only forty-eight hours. The additional spiders were, however, superfluous. In about a week the larvæ had eaten all the food they craved. They then floundered about, apparently looking for a place to pupate. I placed a small paper tube near them but neither larva used it, and in about another week both died.



Cretaceous bad lands on the north fork of Sand Creek, Red Deer River, Alberta. An incomplete skeleton of *Palæoscincus* and other fine specimens were obtained from this locality by the American Museum expedition of 1915

A SUPER-DREADNAUGHT OF THE ANIMAL WORLD

THE ARMORED DINOSAUR PALÆOSCINCUS

BY

W. D. MATTHEW*

SIXTY-SIX years ago Professor Leidy, of Philadelphia, described an odd-looking fossil tooth that had been brought back by the explorer-geologist, Ferdinand V. Hayden, from the bad lands of central Montana. Leidy named it *Palæoscincus* because it resembled the tooth of a small modern lizard known as the skink. Probably very few people outside of professional zoölogists have ever heard of the skink.[1] It lives in the Mediterranean region but there is nothing especially interesting about it, except that it was used in mediæval times as an ingredient of some of the horrible messes that physicians of those days used to concoct and administer to their unfortunate patients. That, however, is by the way.

[1]*Scincus officinalis*.

Doctor Leidy suspected that the *Palæoscincus* was a dinosaur rather than a lizard, as the tooth was of the same general type as in the *Iguanodon*.[2] In those days, however, they did not know much about dinosaurs and it was not possible to be sure of the real affinities of the animal. *Palæoscincus* remained in the limbo of doubtful and half-forgotten names until recent years. There is much that we don't know about dinosaurs even now, as will appear before the close of this article; but a great deal has been ascertained in the course of the last twenty or thirty years, chiefly owing to the explorations and researches of half a dozen leading American museums, and

[2]*Iguanodon* and *Megalosaurus* were two gigantic extinct reptiles which Mantell described about a century ago from the Wealden formation of England and which were so remarkable and different from any living reptiles that Owen proposed the name Dinosauria for them.

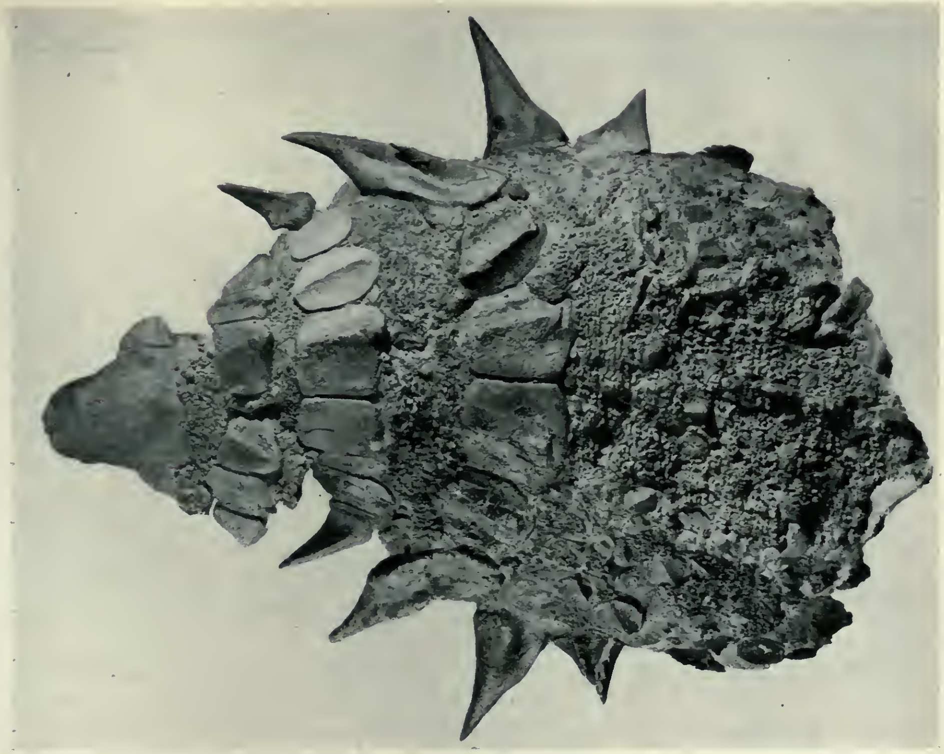
*Curator-in-chief, Division of Mineralogy and Geology, American Museum.

The broad, flat head and wide body, with great spines along the sides, seen in this front view of the *Palæoscincus*, suggest a gigantic and exaggerated "horned toad." The limbs are very stout and massive, to carry the great weight of the animal

among many other interesting discoveries is that of the kind of animal that Leidy's *Palæoscincus* really was.

In 1915 Mr. Barnum Brown, associate curator of fossil reptiles in the American Museum, obtained a magnificent collection of dinosaur skeletons from the Red Deer River in Alberta. Several of them belonged to the group of great armored dinosaurs which he had described from Montana in 1908 under the name of Ankylosauridæ. When he studied and compared these Alberta skeletons, he found two kinds, one of which appeared to be the *Ankylosaurus*, while the other had teeth identical with the *Palæoscincus* which Leidy had described more than half a century before. We had found out at last what the *Palæoscincus* was like and a most extraordinary beast he was, as we shall see.

The capstone to the discovery was provided by Mr. Levi Sternberg, who, while hunting dinosaurs in the Alberta fossil field with his father, the veteran fossil-hunter, C. H. Sternberg, discovered an armored dinosaur specimen that had the armor all preserved in place, covering the fore part of the skeleton. It was indeed pretty badly preserved, distorted and collapsed under the pressure of the hundreds of feet of sediment that had been piled on top of it in subsequent geologic ages, the upper surface flattened and crushed down into the under side, one fore limb crushed under the body, the other missing; while the entire hinder half of the body and tail had been destroyed by erosion when the Red Deer River cut its great cañon through the heart of the Alberta plains and thereby brought to light the long-buried skele-



Protected by thick plates and massive spines, this great armored dinosaur, the top view of which is shown in the picture, must have been a veritable super-dreadnaught of the animal world. Observe the rows of large plates in the neck region and fore part of the trunk

tons of their ancient fauna. However, the specimen offered possibilities of finding out what this armored dinosaur was like and especially how the great armor plates were arranged on the body. Generally the great plates and spines associated with the fossil skeletons of armored dinosaurs are found so jumbled and heaped together that their emplacement during life is mostly guesswork.

On Mr. Brown's recommendation this specimen was purchased for the American Museum and the work of preparation and mounting entrusted to Messrs. Otto Falkenbach and Charles Lang. The task proved very difficult and tedious. The true skin, anatomically speaking, was not preserved but only the impressions of it and the innumerable little nodules of bone imbedded in it. In the skin were set at intervals, in more or less regular arrangement, the larger flat plates and spines. The bone was mostly soft and brittle, crumbling, at times almost pulverulent, and buried in a sandstone matrix which, while not hard, was much harder and firmer than the bone and exceedingly difficult to dislodge without damaging the delicate surface. As each little bit of the surface was exposed, it was necessary to strengthen it by repeated soaking with shellac and other hardening fluids, and the work of preparation extended over months. By dint of the utmost skill and patience the fore-limb bones were dissected out and most of the bones and skin of the under side were separated, so far as they could be recognized. Then bit by bit, the flattened and distorted upper surface, with the backbone and ribs attached beneath it, was restored to its natural curvature and mounted on a steel framework, the bones of the under side set in position and the surviving fore limb articulated and mounted.

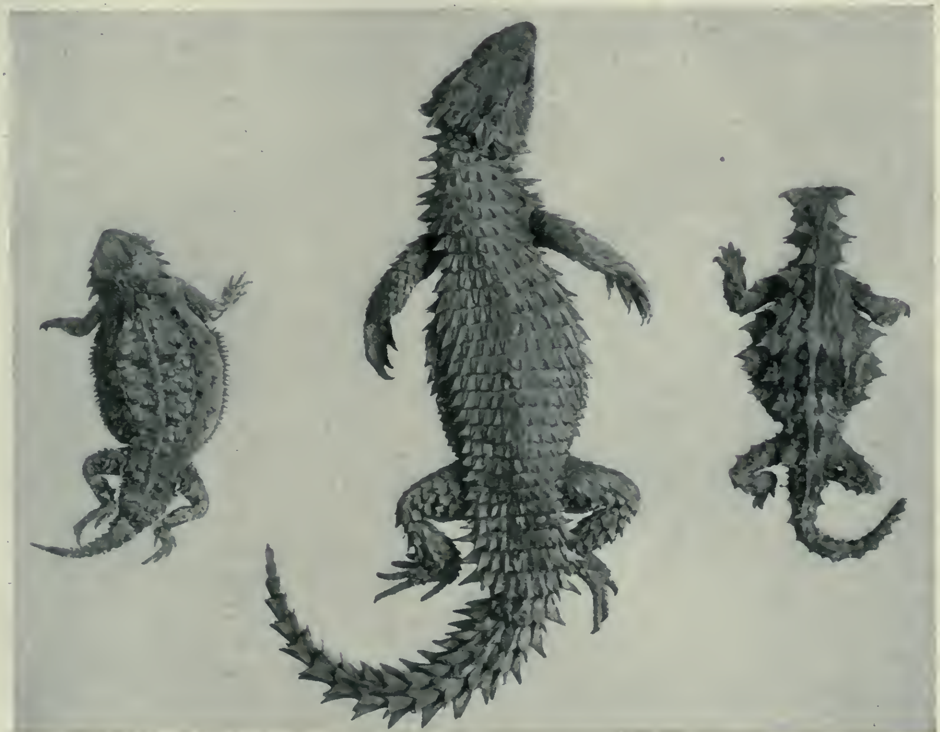
The total time spent on this specimen was 223 days, most of it consumed in the cleaning of the surfaces and in dissecting apart those that were crushed together. Such expenditure of time can be justified only by exceptional scientific or exhibition value in the specimen. We knew beforehand that the *Palæoscincus* would provide important and very much-needed evidence as to the arrangement of the plates and spines in this group of armored dinosaurs. It has turned out a much better exhibition specimen than we had expected, and for this the skill and ingenuity of the preparators are chiefly responsible.

As finally prepared and mounted the specimen shows very well the outward form and proportions of this great armored reptile as far back as the middle of the body. No attempt has been made to reconstruct the missing parts, except for a few small areas near the border where the skin has been restored between the bony plates, chiefly to hold them in position. Otherwise the rows of plates and spines and the intervening skin, studded with small, bony nodules but evidently flexible during life, are restored to their natural relations by the exact fitting of breaks in the bone caused by crushing and by the resetting of displaced spines or plates that were obviously paired with others still in position, or clearly belonged in series with them as proved by characteristic peculiarities of modeling.

It would have been far easier for these skilled preparators, expert in all that pertains to plaster work and modeling, to restore the armor and skin of the animal, setting the big plates and spines by guesswork in some more or less plausible arrangement that would probably have been not very different from the actual structure, and to give to the specimen so finished an appearance that even an expert could hardly have detected that it was "faked." But that is not done at the American Museum. It is wholly against the principles of that institution, one of the objects of which is to recover and preserve the evidence upon which scientific knowledge of these extinct animals is based. The more important and interesting specimens are placed on exhibition, and in many cases it is advisable to restore or outline missing parts; but care is always taken to indicate clearly what parts are restored, and to state on the labels the evidence (usually other skeletons of the same or nearly related species) upon which such restored parts are based. The standards of the Museum are exacting in this respect and are loyally lived up to by the staff, who well understand that the reputation of the Museum and the real and solid progress of science depend upon the strict observance of such standards.

The *Palæoscincus* was a huge armored reptile with a broad, short body, massive legs, thick, heavy tail, and a small, flat-topped, triangular skull. The proportions of the hinder parts are known from other skeletons found by Mr. Brown in Alberta, but the exact arrangement of the armor of the hind quarters and tail is not yet known. Undoubtedly, as in other nearly related armored dinosaurs, there was a series of rings covering the root of the tail and heavy plates enclosing the tip. Probably also the great spines and plates that belong upon the hind quarters were arranged in a series corresponding to those of the fore quarters, as they are in various other animals of more or less similar type, especially in some of the modern spiny lizards. The "horned lizard" (*Phrynosoma*) of the western states, commonly known as the "horned toad," the "spiny lizard" of Africa, *Zonurus*, and the "Moloch lizard" of Australia, are not unlike the *Palæoscincus*, although of diminutive size by comparison. The arrangement of the spines and plates of *Palæoscincus* is a combination of the wide, flat, laterally projecting spines of the short-bodied "horned lizard," the serried rings of the "spiny lizard," and the irregular armor of the "Moloch lizard." The arrangement of the armor on the hind quarters and tail probably corresponded in a similar way to that of these three modern analogues.

Palæoscincus, however, has longer and much stouter legs in proportion to the body than modern lizards, and in this, have the legs greatly reduced or altogether absent, and wriggle along the ground like snakes. The dinosaurs in this respect are like the mammalian quadrupeds, which spend a large part of their time on their feet, with the body carried clear of the ground, and are capable of prolonged walking or running for long distances without interruption. The legs of the *Palæoscincus* are stout



Three modern lizards which, save in their diminutive size, are suggestive of the *Palæoscinus* of the Cretaceous Period. The "horned toad" to the left is nearest in proportions. The "spiny lizard" in the center and the "Moloch lizard" to the right also have some points of resemblance. The figures are about two-thirds natural size. Were the little modern lizards as large as a hippopotamus, they would be monsters almost as strange as the long-extinct armored dinosaurs

among other characters, shows its dinosaur relationship. For the dinosaurs, although so different from one another in proportions, have all of them comparatively well-developed limbs, while nearly all modern lizards and crocodiles have small and slender legs that carry the weight of the body only for short dashes, the animals resting upon the ground between whiles. Many lizards but unusually short for a dinosaur and the feet rounded and compact, with short toes and small, flattened hoofs. A rhinoceros has longer limbs but not so massive, as he has less weight to carry.

The skeleton of *Palæoscincus* bears throughout the marks of slow and very limited movement; even the modern tortoises are agile by comparison. Yet the animal must have obtained food adequate to nourish his giant carcass and only an abundance of succulent vegetation would seem to provide a supply sufficient to sustain so huge a creature. We know from the study of the rock formation in which the remains are found and from the associated plant and animal remains, that he lived in what was then a great delta plain, watered by rivers coming from higher land to the eastward, a low and swampy region with an abundant vegetation, some of which is still preserved in the great coal fields of Alberta. The region enjoyed a warm climate, as shown by the palms, figs, plantains, and other tropical trees preserved as fossils. An animal of the type of *Palæoscincus* would not be well suited to aquatic life and the feet are not well adapted to marshy ground; so that we may suppose that he kept to the drier parts and sandy stretches along the streams to avoid being mired in soft ground.

The short, small head is like that of a tortoise in having a broad, rounded, horny beak used to nip off vegetation; and for chewing the food thus secured *Palæoscincus* had, in addition to the small and rather useless teeth, a couple of stout, horny plates on the upper and lower jaws. Like the tortoise he was well protected against carnivorous enemies, but in a different manner. The tortoise, small or of moderate size, must case himself wholly in armor and withdraw head, limbs, and tail behind an armored barrier. His enemy may then drag him around and turn him over and over, but can find no chink in which a tooth or claw can be inserted.

The *Palæoscincus* was differently proportioned. His tail was too large and massive to be drawn within the body armor. Hence, it had to be cased in rings of bone, overlapping and somewhat flexible so as to preserve some freedom of movement, and was especially protected at the vulnerable tip by very heavy plates. His head, a massive block of bone, had bony sheaths to cover the eyes, nostrils, and the sides of the jaws; the horny beak needed no protection. The broad neck was protected by rows of large, thick, flat plates arranged in rings that afforded no purchase for the jaws or claws of his enemies, the great carnivorous dinosaurs. The back was covered with similar flat plates, less regularly arranged, and the sides of the animal with stout spines, some of them a foot or more in length. The limbs could probably be drawn under the body and required no especial protection; but at the shoulders and probably at the hips, large spines projected outward and forward to cover a possible point of attack. Too massive and heavy to lift, too broad and flat to roll over, his sides and under parts thoroughly protected or out of reach when he squatted down upon the ground, the *Palæoscincus* must have been invulnerable or nearly so, even to such huge and powerful enemies as the carnivorous dinosaurs whose fossil skeletons are found associated with his in the bad lands of the Red Deer River. What formidable enemies these must have been one may judge from the three skeletons mounted in the hall of dinosaurs, American Museum—one of them in a running pose, a second standing, the third in the position in which it lay when found in the rock. No such giant carnivores, nor any approaching them in size, inhabit the earth today. The largest lions, tigers, or bears are far smaller, and if the *Palæoscincus* lived at present, he would have no need of such huge and massive armor for defense.

Why, then, did the animal not survive? Was it that, in spite of his massive and elaborate defense, the great carnivorous dinosaurs found some weak spot, or that his armor was inadequate against the attack of the still huger *Tyrannosaurus* that appeared upon the scene a little later in geologic history? Or was it that, although the adult was so armed as to be practically immune from attack, nature could not, or did not, provide an adequate defense for the eggs, presup-

RESTORATION OF THE PALÆOSCINCUS

A huge and slow-moving reptile with massive armor, designed for protection against the gigantic carnivorous dinosaurs. Restoration by E. M. Fulda, 1921 posing that eggs were laid, and for the young? We know nothing at all about the development of the young of *Palæoscincus* nor, for that matter, of any other dinosaur. We do not even know whether dinosaurs laid eggs. Most reptiles do but some are viviparous. A few fragmentary remains of half-grown dinosaurs have been found, but on the whole the rarity of young animals is very remarkable. They may have lived in some different habitat from the adults—perhaps in the uplands or away from the streams and marshes, so that their remains are not preserved. Whatever the cause, we know nothing of them and can only speculate as to their enemies being a factor in causing the extinction of the group.

Professor Cope once suggested, more or less humorously, that the little, opossum-like mammals found in the same formations as the huge dinosaurs were in the habit of sucking the eggs of these giant reptiles, and that their depredations finally brought about the extinction of the group. A more probable suggestion, advanced by Professor Henry Fairfield Osborn, is that epidemic diseases transmitted by insect pests may have caused the extinction of many of the large animals of former times, just as the cattle pest and other epidemics have swept away so much of the modern large game of Africa. These and other causes are possible or probable factors in the extinction of the Mesozoic animals, but there is no way at present of finding out whether they really did play an important part.

There are, however, certain conditions that assuredly did exist and that may have caused the disappearance of the *Palæoscincus* and other giant reptiles. One of these is the appearance of the mammals—animals which even at that stage of their development were of much higher intelligence than the dinosaurs, so far as we can judge from the brain casts of the different types. Dinosaurs had brains of small size compared with their huge bodily proportions, and of low type, indicating an intelligence scarcely as high as that of a modern crocodile or lizard. The mammals of the beginning of the Tertiary period had brains that were inferior to those of any modern mammals, of lower type even than those of the marsupials, but still of much higher grade than any reptilian brain. Their teeth and other organs for seizing and devouring their prey or digesting vegetable food were also in various respects better and more adaptable, and they had other points of superiority. Nevertheless, it is scarcely possible to perceive any way in which those earliest mammals could have come into competition with the dinosaurs that we are acquainted with. So far as we know, the early mammals at the end of the Age of Reptiles were all small creatures of such different habits and adaptations that they could not have come into any direct competition for food and pasture with the giant dinosaurs or in any serious degree have interfered with their welfare.

In a very indirect way indeed, the superiority of the mammals may have been a principal cause of the fall of the reptilian dynasty, but for the more direct reason for the extinction of the great dinosaurs of the Upper Cretaceous we must look to other causes. This much is clear, that they were gigantic and highly specialized animals, adapted to certain special modes of life and a particular environment, requiring on account of their great size a very large amount of food, and therefore liable to perish wholesale if this food should become scarce or the environment change and become no longer suitable. A smaller and less specialized animal could alter his habits and food to fit the changed environment, and might well survive where the giant dinosaurs would become extinct.

Moreover, all modern reptiles, owing to their comparatively slow and imperfect blood circulation, are cold-blooded.

That is to say, their body temperature varies with the temperature of their surroundings and they are not able to maintain a consistently high, uniform temperature of the body in the face of much colder surroundings. They grow torpid in the cold and are quite unable to maintain an active life, and must either find refuge in caves and deep burrows or perish. This appears to be an incurable defect in the reptile, as his scaly or horny skin allows the heat of the body to escape readily. Mammals and birds, on the other hand, are covered by a non-conducting coat of fur or feathers that enables them to retain the heat of the body, and has allowed them to build up a much more active and perfected system of blood circulation. This in turn is fundamental to more active habits of life, higher brain development, and other points of superiority. If this difference in the character of the skin-covering be the underlying reason for the limitations of the existing races of reptiles, it is certain that the dinosaurs were similarly handicapped, as they had the same general type of scaly or horny covering. The modern reptiles are quite unable to maintain an active life in the northern winter and, in consequence, are chiefly found in tropical or warm temperate regions, those which do range farther enduring the winter only by retiring to caves or burrows and hibernating there.

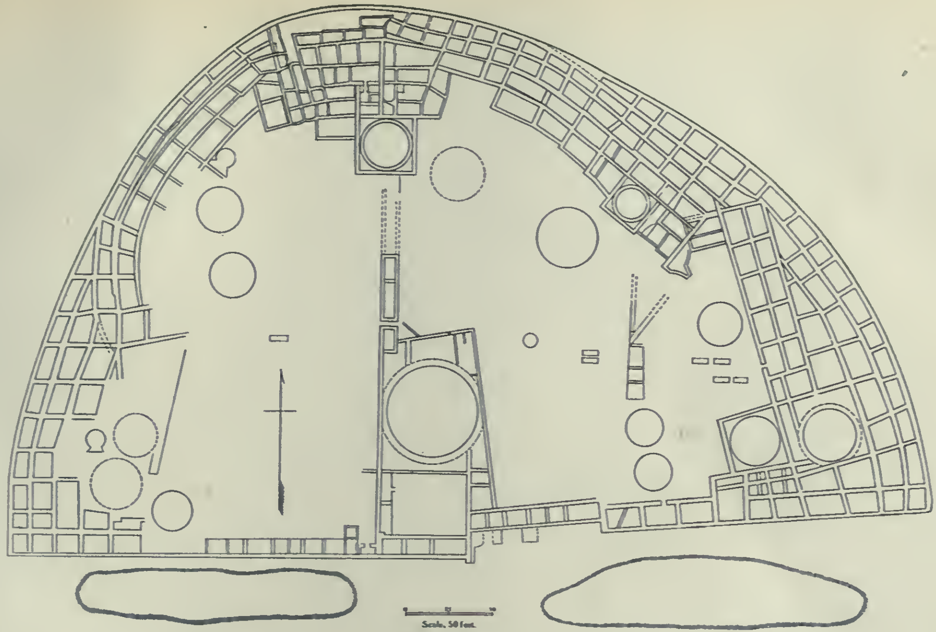
At the time that the giant dinosaurs flourished a warm climate extended over all the temperate and even Arctic regions, if we may judge from the tropical flora associated with them. It was also a time when vast swamps and deltas and heavily forested lowlands stretched over a great part of the land areas, in contrast to the great plateaus, mountain ranges, and arid or desert interiors that characterize our modern continents. Toward the end of the Age of Reptiles a great progressive change was going on, certainly in the physical geography and apparently in the climate as well. Its early stages are shown in the slow rising of great parts of the flooded continental interior above sea level, turning them into delta and coastal swamp and then into plains and upland, while great stretches of the ancient land were more violently uplifted into high mountain ranges, whence the rivers brought ever-increasing floods of sand and mud to spread over the plains and marshes and build out deltas far into the shallow seas, burying the old lagoons and flood plains of the Cretaceous under great thicknesses of sediment, filling up and drying out the swamps and changing the environment in which the dinosaurs lived. More important probably was the change of climate which seems to have been going on at the same time that these geological changes were taking place. While on the one hand we find in the Cretaceous formations as far north as Greenland a fossil flora of warm-temperate type, on the other we find the evidences at the beginning of the Age of Mammals of glaciers existing as far south as southern Colorado. The evidence is very scattered and fragmentary, and scientific opinions vary a good deal as to just how it should be interpreted, but it would seem that a great change in climate must have been in progress at that time, from moist, subtropical, and warm-temperate conditions prevailing over all the world, to climatic contrasts much more like those that exist today. Such changes would necessarily sweep away the ancient swamps and forests and alter the entire character of the vegetation almost everywhere. The dinosaurs, highly specialized and adapted to the old conditions, unable to withstand the cold and too bulky to seek refuge in caves or burrows, would disappear and become wholly extinct.

The dinosaurs were the last survivors of the various groups of giant reptiles that dominated the life of the Mesozoic Period, or Age of Reptiles. The great sea reptiles—ichthyosaurs, plesiosaurs, and marine crocodiles,—the mosasaurs that lived in the shallow seas, and the pterodactyls that flew above them, had already become extinct. With the closing of this last scene of the Age of Reptiles the scenery is shifted, the background is changed, and the stage is cleared and set for the next great act in the drama of geologic history, the Age of Mammals, with the evolution of modern quadrupeds and of birds as its keynote.

The direction of evolutionary progress in the dominant types of life has changed. In the Age of Reptiles, at least in its later phases, the struggle for life, the competition between the different reptilian types, is concentrated on the development of offensive and defensive weapons of gigantic size and elaborate armature. It culminates in the huge *Tyrannosaurus* with its terrible teeth and claws, in the great *Palæoscincus* with its massive armor of plates and spines. In the Age of Mammals, on the other hand, the emphasis of evolutionary progress is shifted to the development of agility and speed, of adaptability to changing conditions of life, of a higher type of brain, the last feature foreshadowing the final act, the keynote of which is to be the dominance of intelligent life in man.

I have always found it somewhat difficult, and perhaps others may as well, to conceive of the Age of Reptiles and the extraordinary and nightmarish creatures that then populated the earth, as other than a fantastic dream. They are such strange and unexpected combinations, such caricatures and exaggerations of existing types of animals, that even with the help of mounted skeletons or modeled restorations it is hard to conceive of them as other than the creations of fancy. I have spoken of them as the actors in a great epic drama, a representation of the History of Life on Earth, and so indeed it is easiest to picture them. Yet they did once exist, not merely upon the stage, but in real life. They are no creations of fancy. And this *Palæoscincus*, now on exhibition at the American Museum, showing before our eyes the veritable outward form and garments of one of the strangest of these strange extinct reptiles, may go far to help us realize that they are not creatures of the imagination.

Miniature models of the armored dinosaur, by Charles Lang and Otto Falkenbach. Slight differences in the two models, especially in the tail region, show the varying opinions of experts when restoring the missing parts from other specimens



Ground plan of Pueblo Bonito. Prepared by Mr. B. T. B. Hyde from the general ground plan of the pueblo made by Mr. N. C. Nelson and from the field notes and room plans of Mr. George H. Pepper

PUEBLO BONITO AS MADE KNOWN BY THE HYDE EXPEDITION

BY

CLARK WISSLER*

ONE usually thinks of a cañon as a deep, narrow cleft in rock, through which flows a wild, boisterous river. But in the arid stretches of New Mexico and Arizona one often meets with dead cañons, as it were, through which, in ages long past, real rivers did flow but which are today streamless. One of the best known of these is in northwestern New Mexico and is named Chaco Cañon. The mighty river that once plowed out this great trench in the sandstone has disappeared, although an occasional rainstorm may start a sorry, halting stream that soon sinks out of sight into the sand.

The main cañon is about twenty miles long and varies in width from three-quarters of a mile to a few hundred feet. The side walls are for the most part steep, sometimes rising to a height of 125 feet. Imagine the lower Hudson flanked on either side by palisades, its stream run dry, and the winds whirling the white sands about in its bed,—the resulting picture will be not unlike Chaco Cañon. The chief interest in the Chaco, however, lies not in the cañon itself, but in the magnificent ruins it contains. For there was a time, long before the white man came, when a people lived down in this cañon. That in their day these cañon dwellers were far from commonplace is attested by the ruins left behind, among which are some of the most remarkable to be found within the whole United States. Of the large ruins there are twelve, and among these is the now famous Pueblo Bonito, a building of huge proportions and in a fair state of pre-

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A VIEW ACROSS CHACO CAÑON

In the middle foreground is Pueblo del Arroyo, so named because of the ancient stream bed that winds past it. The wide opening in the background is known as the Gap

PUEBLO BONITO VIEWED FROM THE NORTH

The standing semicircular back wall is clearly seen on the left of the picture. At about the center of the highest part a wall of later construction was spliced or joined to the older masonry, thus increasing largely the number of outside rooms. The line of cleavage of the old wall and the new is clearly shown on p. 350. The large refuse heaps can be seen along the front of the ruin and numerous excavated rooms in the foreground

Some of the important excavations made by the Hyde Expedition are indicated in this picture

servation. This ruin, which first came to notice in the writings of Josiah Gregg in 1844, was described in some detail by Lieut. J. H. Simpson in 1849, and again by William H. Jackson in 1878. It may be of interest to quote from the description of Lieutenant Simpson.

"Two or three hundred yards down the cañon, we met another old pueblo in ruins, called Pueblo Bonito . . . . The circuit of its walls is about thirteen hundred feet. Its present elevation shows that it has had at least four stories of apartments. The number of rooms on the ground floor at present discernible is one hundred and thirty-nine. In this enumeration, however, are not included the apartments which are not distinguishable in the east portion of the pueblo and which would probably swell the number to about two hundred. There, then, having been at least four stories of rooms, and supposing the horizontal depth of the edifice to have been uniform from bottom to top, or, in other words, not of a retreating terrace form on the court side, it is not unreasonable to infer that the original number of rooms was as many as eight hundred. But, as the latter supposition (as will be shown presently) is probably the most tenable, there must be a reduction from this number of one range of rooms for every story after the first; and this would lessen the number to six hundred and forty-one. The number of *estuffas* [kivas] is four—the largest being sixty feet in diameter, showing two stories in height, and having a present depth of twelve feet. All these *estuffas* are, as in the case of the others I have seen, cylindrical in shape, and nicely walled up with thin tabular stone. Among the ruins are several rooms in a very good state of preservation—one of them (near

Interesting objects, including ceremonial sticks and pottery, were unearthed in this section

the northwest corner of the north range) being walled up with alternate beds of large and small stones, the regularity of the combination producing a very pleasing effect. The ceiling of this room is also more tasteful than any we have seen —the transverse beams being smaller and more numerous, and the longitudinal pieces which rest upon them only about an inch in diameter, and beautifully regular. These latter have somewhat the appearance of barked willow. The room has a doorway at each end and one at the side, each of them leading into adjacent apartments. The light is let in by a window, two feet by eight inches, on the north side. There was among the ruins another room, which, on account of the lateness of the hour and the consequent despatch of our examination, escaped our scrutiny."

The report of Jackson in 1878 added little of importance to the subject, and so the great ruin remained until the several publications alluded to came to the notice of Frederick Ward Putnam, the distinguished anthropologist at Harvard. From a study of these reports Professor Putnam saw reason to believe that Bonito and the Chaco Cañon held the key to the story of the Southwest. Putnam was a born teacher and a leader of men, so it is not strange that two of his students, Messrs. B. Talbot B. Hyde and Frederick E. Hyde, Jr., were fired with the zeal of the master. It so happened that the Hyde brothers made the acquaintance of Richard Wetherill, a resident of the Southwest already famous as the discoverer of the cliff dwellings of that region. Wetherill had long known the Chaco and its ruins and was keen to see Bonito uncovered.

When the Hyde brothers laid the project before Professor Putnam, they found him a more than sympathetic listener. Just previous to this, Professor Putnam had been appointed curator of anthropology in the American Museum. Thus, in short, it came about that the Hyde brothers financed an expedition to the Chaco, now widely known as the Hyde Expedition.

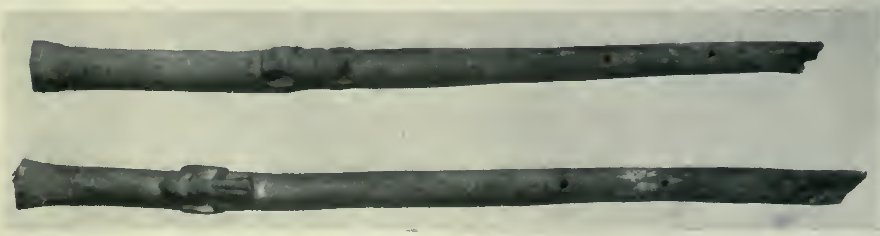
During the years 1896–99 extensive excavations were made in the ruin under the immediate direction of George H. Pepper, formerly assistant curator in the American Museum. A large part of the ruin was uncovered and some of the most beautiful types of pottery and work in turquoise yet found in the United States were discovered. These remarkable objects have long been familiar to visitors to the Museum.

The number of rooms on the ground floor, as revealed by the excavations of the Hyde Expedition, is 268. Owing to the tumble-down nature of the upper walls, it was found impossible to determine the exact number of rooms; but, as estimated, they exceeded six hundred, or approximately the count of Lieutenant Simpson. However, the latter failed to note the large number of kivas, observing but four, whereas the excavations of the Hyde Expedition revealed eighteen, and doubtless still more will come to light with future excavations. Yet Lieutenant Simpson is not to be blamed for this error. Not being familiar with this type of Pueblo architecture, he naturally failed to note the fainter traces of buried kivas. When we consider the obstacles encountered by Lieutenant Simpson in his initial survey, necessarily made without the help of excavations, the clearing away of fallen logs and of drifted sand, the accuracy of his observations is truly remarkable.

Since 1899 the Hyde brothers have not found it possible to continue exploration in the cañon, so Mr. Pepper has prepared a full report of his work at Bonito, which has recently been issued by the Museum as Volume 27 of its *Anthropological Papers*. It consists of 398 pages, with 167 illustrations, 8 of which are in color.

Interest is now added to this publication by the resumption of excavations at Bonito by the National Geographic Society and the United States National Museum. At the hands of these institutions Bonito is to be entirely uncovered, the walls repaired and the whole maintained as a National Monument for the enjoyment and mental stimulation of all who travel in the Southwest. We are thus assured that the important work initiated by the Hyde brothers, at great personal sacrifice, will be carried through to completion, and that this ruin, one of the grandest of prehistoric time to be found in America, will be thoroughly known and properly appreciated.

To the Hyde brothers belongs also the credit of the first serious attempt at intensive archæological work in the Southwest. It was the results of this work in particular that directed the attention of scientific men to the problems of the Southwest and may therefore be considered the first step, as it were, to that end.



Flageolets ornamented with animal figures carved in relief. The figure on the upper instrument is, according to Frank Hamilton Cushing, that of a bear. The carving on the lower flageolet represents, in the estimation of Mr. George H. Pepper, a mountain lion

EXCAVATED ROOMS

More than once when an apparently solid floor had been reached in the course of excavation, further digging brought to light additional chambers beneath; these were of various forms and shapes and often of a different architecture from the walls above

Here can be distinctly seen the line of junction of the original outer eastern wall of Bonito with the new outer wall that was built at a later period in the history of the pueblo

This type of kiva, or ceremonial chamber, is characterized by the low, benchlike platform around the wall. The openings in the wall above the platform supported the beams carrying the superstructure. In these beams are usually found in cuplike depressions small offerings made by the builders

This small circular room, quite different from any other in the ruin, was floored with worn-out and useless metates which had been inverted and placed about a circular stone

It is possible that this room was set aside for the preparing of meal for ceremonial purposes, the metates, which show great wear, being used to this end

A ceiling, the top layer of which consists of cedar splints placed at right angles to the layer of cottonwood poles below. Notice also the smoothed surface of the stones on two of the fragmentary walls

It must have been an arduous labor to split out, trim, and smooth the boards used in the floor of this room. As was often the case, the weight of the débris from above had broken the supporting beams

These fragments of pottery were subsequently pieced together and their ensemble forms a brown-ware jar of rare interest. The lower, bowl-shaped portion of the vessel is smooth and the upper half carries a deeply incised design

The stone mortar with the balanced, interlocked design in red and white covering the outer surface is a unique example of decorative art. It is the most elaborately ornamented object of this nature that was found in the pueblo

An unusual discovery in Bonito was a hoard of cylindrical jars, a special form of pottery not found elsewhere

Under the floor of this room was uncovered pottery and basket ware buried in circular holes or pits. Later builders in the pueblo did not know of them and constructed a wall over one of the pits

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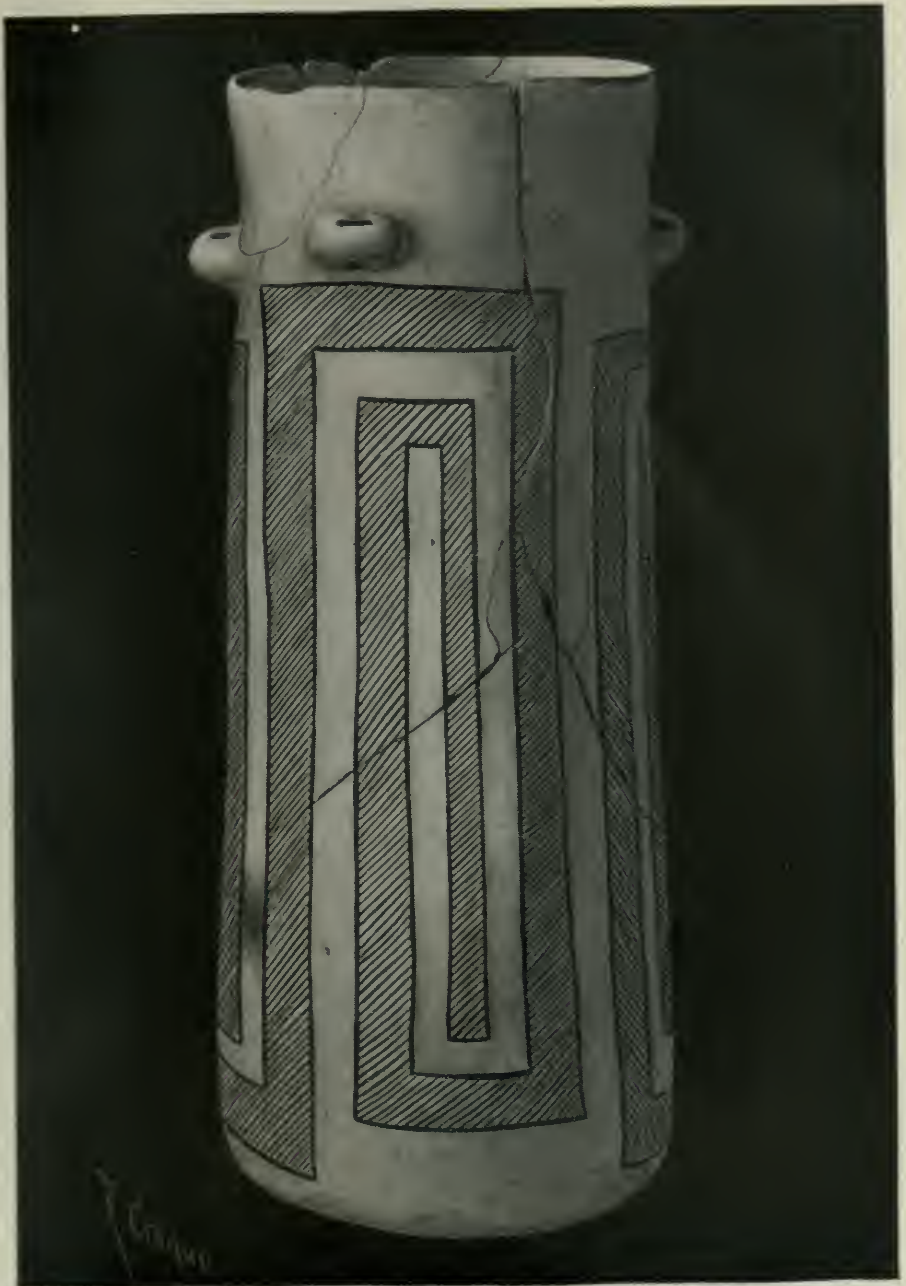


A CHARACTERISTIC JAR FROM BONITO

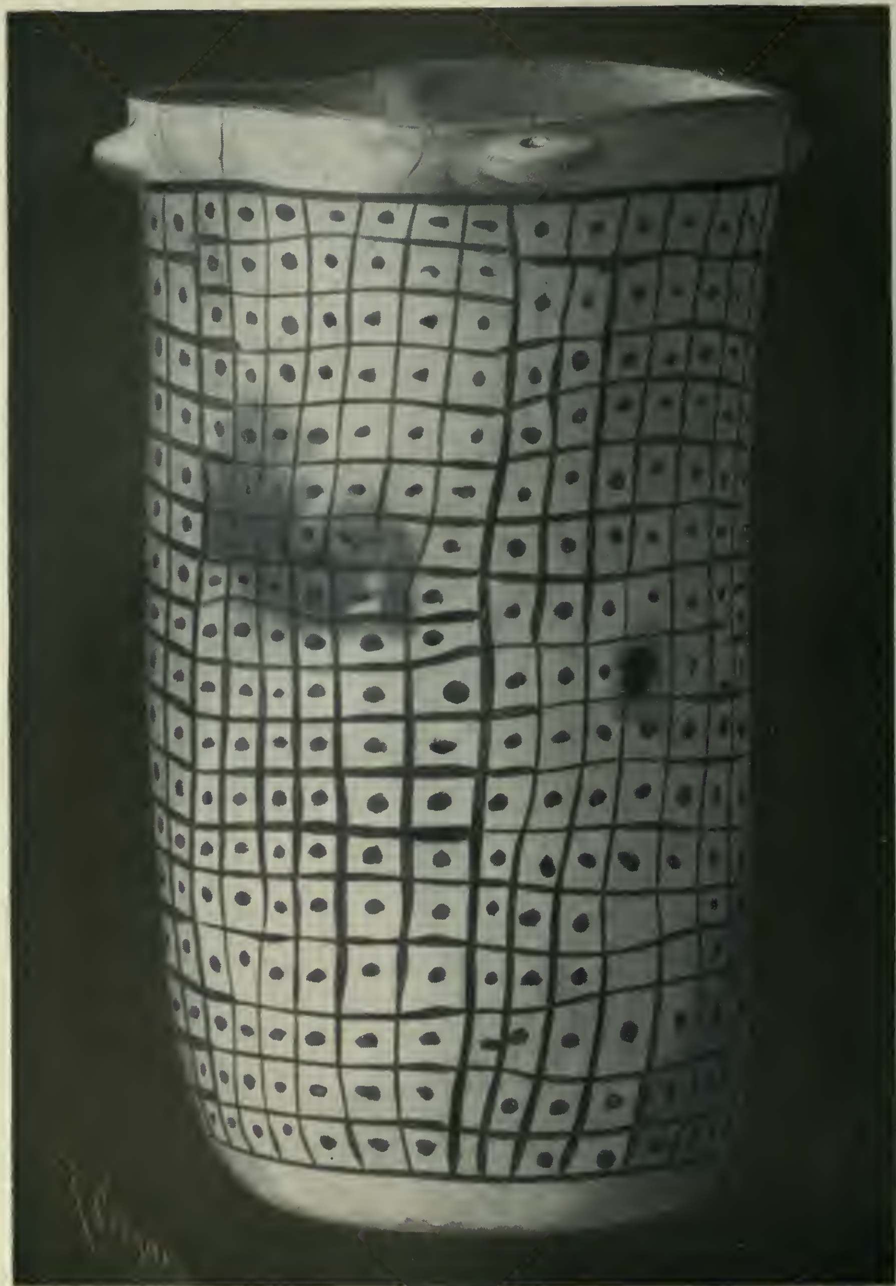
A unique type of pottery was found in Bonito by the Hyde Expedition. One hundred and fifty or more cylindrical jars were found cached in three rooms with a care that suggests their use in some sacred ceremony. No such pottery has been found elsewhere, with one exception. At the Aztec Ruin, about sixty-five miles to the northwest, Mr. Earl H. Morris found the broken parts of vessels of the same form and decoration

BLACK-ON-WHITE WARE

One type of pottery made by the builders of Bonito is known as black-on-white. In the making of such pottery, the vessel was covered with a white slip upon which the designs were painted in black. The specimen represented is a good example of this type of Pueblo pottery, the artist, R. Cronau, having given a faithful copy of the colors

JAR WITH VERTICAL HANDLES

In a single cache of 114 of these cylindrical jars, 66 were found bearing ornamentation. The variation in handles is also interesting. The jars ranged from those entirely without handles to jars with three and four handles, the greater number having four. It has been suggested that these handles may have been intended for the attachment of feathers



JAR WITH DESIGN SUGGESTING EAR OF CORN

It is always difficult to know what was in the potter's mind when such designs as the above were projected. In this case, however, we can be reasonably sure that an ear of corn is intended. Special ears of corn play an important part in the religious festivals of modern Pueblo Indians, and there is every reason to believe that such were held sacred by the builders of Bonito. We infer also that special sacred ears of corn were set up on end as parts of altar decorations. Curiously enough these cylindrical jars have the shape and size of the small basketry stands used by modern Pueblo Indians for holding sacred ears of corn. One may hazard a guess, therefore, that this jar and its design represent such a sacred ear

Exterior view of the building in the Jardin des Plantes where Georges Cuvier lived and worked. Note the bust of the great naturalist with the inscription "Maison de Cuvier"

THE HOUSE OF CUVIER

IN THE Jardin des Plantes in Paris stands a charming old-world building, La Maison de Cuvier, at one time the official residence of Baron Georges Cuvier and still full of mementos of its distinguished occupant. It was in this building that one of the greatest scientists of all times, a man who put the impress of his genius on three important branches of human endeavor—systematic zoölogy, comparative anatomy, and palæontology—was domiciled during the tenure of his professorship at the Jardin des Plantes. Cuvier's connection with the garden dates from 1795, when, through the influence of Lacépède, Lamarck, and others, he was appointed assistant to Mertrud, the professor of comparative anatomy. In 1802 he succeeded his superior as professor of that science and laid the foundations of the collection of comparative anatomy that is still one of the great intellectual attractions of the site.

The Jardin des Plantes is a fitting environment with which to associate the memory of so genuinely devoted a scientist as Cuvier. Founded in the first half of the seventeenth century by Guy de la Brosse, physician to Louis XIII, it was originally nothing more than a Jardin des Herbes Médicinales. In 1793 the museum of natural history was established within its bounds, and today its spacious acres along the banks of the Seine are occupied not only by nursery gardens and greenhouses but also by a well-stocked menagerie, various museum galleries devoted to anatomy, anthropology, botany, geology, mineralogy, and zoölogy, laboratories, a splendidly equipped library, and a lecture hall, where courses are conducted by the most eminent men in all branches of natural science. For the quaint and charming illustrations that follow, NATURAL HISTORY is indebted to Monsieur V. Forbin, of Paris.

CUVIER'S LABORATORY

THE FURNACE (OR *FOUR*) USED BY CUVIER

The garret of the house with several instruments used by Cuvier

Cuvier's hat, on exhibition in the Salle Historique of the Paris Museum

THE FAMOUS LEBANON CEDAR IN THE JARDIN DES PLANTES

Legend has it that Bernard de Jussieu brought the young plant in his hat and shared his water ration with it during the long journey

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ONE OF THE LARGER SETTLEMENTS JUST ABOVE MANAOS

It is built along the hillside out of reach of the rising river. The production of Brazil nuts, rubber, turtle oil, and tobacco gives the people a livelihood

AMONG THE CABOCLOS OF THE RIO NEGRO

BY

WILLIAM J. LAVARRE

THE Rio Negro, which flows into the yellow Amazon some nine hundred miles from the Atlantic, and stretches back its tortuous, forked branches across Venezuela and into the high Andes of Colombia, is the pathway of a little-known clan. These copper-skinned people, whose lineage is of Portuguese, Spanish, and Negro, fused with many tribes of jungle Indians, are born wanderers. They speak Portuguese, Spanish, and *Lingua Geral*, the tongue commonly understood by all the tribes of the Amazon basin. When they are tiny, pot-bellied infants, their voyaging begins; they are jumbled quite gleefully into a crowded canoe, or a *batelao*, with flea-bitten pups, parrots, and monkeys for companions. Later in life they think, as their ancestors did, that it is just as easy and expedient to float placidly over those black waters as it would be to establish themselves permanently in any particular hut upon the lonely shore. The whole of the forest bordering both sides of the river and the many forested islands belong to everyone and to no one, and the Caboclos, as they are called, may roam where they like and squat whenever they have a mind to.

As I was journeying up the meandering Negro not so long ago, I passed settlement after settlement that seemed deserted. High grasses had sprung up, and the dark, convoluted jungle was creeping in on all sides, bent on reclaiming what had been snatched from it temporarily by human beings who had soon grown weary of the sedentary life. In most cases the only reminders of human existence were rough crosses, which marked the places of the dead that were left behind. In the jungle a village in which death has occurred is regarded as hoodooed, and frequently the inhabitants move out of it in great haste. Once, as we glided along close to the shore, a lonely, grunting pig came complainingly down to the water's edge, sniffed, and squealed at us, and at another place a red-plumed cock, with featherless neck, lazily flapped his wings and crowed complete ownership of the abandoned domain. I do not know why even those two living remnants survived unless it was that the pig was too heavy to be carried in the already overladen canoe, or that both the pig and the cock had run into the forest and hidden, reappearing only after the inhabitants had left.

"Where have the people gone?" repeated the uncompassionate Portuguese gentleman who had waxed rich by his industrious operations in rubber, Brazil nuts, and piassaba fiber. "Bah! They go like they come . . . nowheres! *Bichos! Vagabundos!* All the time they go, go, go. They say they go for rubber, to *festas*, because someone has died, but it is all the same; if there were no rubber trees, no celebrations, no deaths, they would go anyway. . . . *Bichos! Vagabundos!*"

When a Portuguese says "*Bicho!*" it is equivalent to our exclaiming "Worm!" I needed nothing more to recognize the feeling of the Portuguese for these folk. He, like all the successful men on the Rio Negro—and they are so few that I could name them on the fingers of two hands—considered the wandering, happy-go-lucky Caboclos as little more than animals, poorest of the poor. They are, as the Portuguese gentleman declared, vagabonds, and they are poor, but I for one wish to speak of their many good, if simple, characteristics. Personally I like them; perhaps there is a certain kindred feeling born of the *Wanderlust*. I have been among them, sharing their already too small huts, eating the same meager food, and listening to them as they talked among themselves, telling charmingly imaginative tales of adven-

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A floating Caboclo household on its way down the river with a load of rubber. In such crafts these people like to spend their life, drifting here and there over the tortuous stretches of the rivers, meeting new people, going to *festas*, looking for ease. They are rolling stones that gather no moss

ture or gossiping about their little happinesses or tribulations.

This is the way my acquaintanceship with them began. I had been beseeching the god of adventure to come my way when, suddenly, one morning, several years ago, I found myself sprawling in the hot sun, nearly a thousand miles from civilization, as represented officially by Manaos, at the mouth of the Negro. A feeling of loneliness came over me as I saw the little American flag which flapped so airily from the stern of the departing launch, on which up to then I had been cruising, fade in the distance. I got out my pistol, loaded it, and stuck it in my belt. Then I sat down on a damp log, fanning insect devils, to await the advent of the first mortal, be it wild man or tame, or coy Amazon. On the Rio Negro I had seen small craft that floated lazily on the current, but they were invariably so filled with people, rubber, foodstuffs, pieces of smoked meat that resembled so many chunks of charcoal, tame birds, chattering monkeys, babies, and what not besides, that the thought that one more thing could be conveyed in them never entered my mind. Such a floating Caboclo household on its way to take up existence at a new location was usually mildly humorous and amazing. Everything would be there save the grass hut, which they could easily fashion if they did not choose to take up their residence at some deserted spot whereon a dilapidated shelter already stood. But even those overladen canoes were not plentiful, and I was not hopeful of coming upon one speedily. However, the unexpected happened, for presently I heard, faintly at first and then louder, the swish, swish, swish of paddles as they cut into water. I hid behind a rock; for I wanted to have a chance to see the occupants of the boat before they saw me.

A moment later I saw a canoe laden with the piled-up possessions of a Caboclo family come from behind the bend and float toward me, and I stepped out of my hiding place. The occupants of the canoe naturally rubbed their eyes upon beholding the lone *Americano*. I fancy that if I should walk into a room some evening and find a naked savage standing before the fireplace, I, too, should be startled. That is not to say that I looked savage or ferocious. I am firmly convinced that at that particular moment I was about as forlorn and affable a creature as could be found anywhere. I raised my voice and yelled at them. When their canoe touched the bank, they began questioning me. I told them the necessary details; enough, at any rate, to assure them that I had not, as they suggested, fallen like a bad angel from the skies. They looked at each other and conversed in low whispers. "*Muito mal!*" the old man of the party exclaimed at last. Yes, I agreed heartily, it *was* very bad. Could they give me a lift? The old man looked at the almost submerged boat and then at me. "*Caramba, Senhor*, but if we place a cobweb more on this *canoa* she sinks!" They looked at me and shook their heads. "It is not possible!" From the pile of humanity and supplies I separated two old men, two young men, two old, toothless women, a bland-faced girl and several (I could not disentangle them exactly) babies. Again I mentally agreed with what the old man had said. They certainly could not have carried me.

The venerable spokesman began lisping like a knight of old Castile, "We are bound for our *sitio*. We will go there quickly and then in the empty boat some of us will return for the *Senhor*. Will that be all right?" "How far is your home?" I asked. "A little way," he answered. I had to smile and be content. "All right," I announced, "I'll be waiting here." Without another word or a nod they pushed off and were soon lost to view behind the lower bend.

Through the long hours of the day I sat watching the green and red lizards that scooted across the ground holding their long tails high in the air. Macaw-parrots flew through the azure sky, and small, gay birds played hide-and-seek with each other in the scrubby bushes along the water's edge. I gasped with pure delight when a scintillating spot of almost ethereal blue came fluttering from the gloomy, wall-like foliage behind me, like some spirit from another world—a gorgeous, blue butterfly of that species which has led so many enthusiasts into ill-fated adventures. I recalled old Johnstone, distributor of Bibles to the heathen, naturalist, and explorer, with his horribly twisted mouth (moonstruck, he said) who had chased such a butterfly into the coils of a giant boa constrictor. I sat still as the butterfly hovered above my head and then started suddenly away toward the forest, pausing in turn for a moment and then returning to hover a second time close to my head, as though it were trying to entice me to give chase. "No you don't, you beauty!" I protested. "You are exquisite; you are enticing but you're a siren!" As though it understood what I had said, it alighted on my knee and, seeing I made no attempt to clutch it, edged over to my wrist and then on to my fingers. The beauty of the design and the blending of those different hues of blue were marvelous, and I breathed carefully lest I disturb my woodland visitor. It pulsated a moment longer on the tip of my thumb, aglint like an iridescent gem, and then, floating tantalizingly away into the dense forest, was lost.

Just as I was thinking of improvising a shelter from the twilight storm that lurked in the eastern heavens and of lighting the proverbial fire which keeps wild animals away, I heard renewed swishings and made out the form of a canoe approaching from downstream. "*Senhor Americano*, are you there?" a voice called, and I stood up and greeted my rescuers. When they had run the bow of the boat upon the shore, the three paddlers helped me with my small duffle-bag and large metal jars of pickled snakes and other reptiles which I had been collecting. When I explained to the natives that the jars contained reptiles, the men laughed; they wanted to know what good they were—was I going to eat them?

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A somewhat elaborate native home with thatched roof and adobe sides. The natives love waving palm trees and cultivate them whenever they can

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The father of this family secretly wished to marry off his two daughters because, as he confided to the author, women are too expensive. "They always want you to buy them gaudy cloth that fades and vaseline that loses its smell"

We journeyed down the stream in the darkening evening, cooled by a rising breath of air. No sound disturbed our going save the dismal cry of a night bird, the continual swish, swish, swish of the paddles, and the gentle lapping of the wavelets against the boat.

"What will the *Senhor* do?" they asked me.

"I want," I confided to them, "to get down to Sao Isabel where I can board the little steamer that goes monthly to Manaos— Can I?"

I heard a giggle in the darkness. . . . "Can the *Senhor* swim?"

But I felt in no mean mood. Having been saved from a lonely and hungry night, I was suffering rather from a reactionary spell of joviality. I could swim, I assured them, but my snakes could not, and I vowed I wouldn't go a step, or a stroke, without my snakes. They were going with me to the Museo Americano! That struck them as very funny and they laughed a good while. Maybe it was. I think of it now as only an idiosyncrasy of the moment; sometimes, you know, a drowning man will clutch his treasures though they weigh him down.

A little before midnight a flickering red glow became visible on the shore on the right, and from it a slender reflection gleamed out over the water like a jagged javelin of shimmering fire. We turned toward it and soon ran the bow of our canoe upon a low stretch of sandy beach. Upon the higher bank a small fire burned, and moving carefully toward it over the uneven ground, I found a shadowy, palm-thatched hut fronted by a deep, cool portico. Within one of the two rooms burned a rag wick protruding from the apex of a small conical tin of oil which had been placed on a tiny shelf that jutted out from the smooth wall of patted white clay. In the uneven light I was able to make out only the dim forms of several people swaying in net hammocks. We did not disturb them. I swung the hammock which my host had given me across the cooler portico, and my rescuers went within after bidding me a soft "*Boas noites, Senhor.*"

When I opened my eyes the next morning, I found a cup of coffee held out toward me by a smiling, bare-legged maiden. I smiled back sleepily at her, whereupon she fled, leaving the cup in my hands. The liquid was black and thick, and had been sweetened by the juice of sugar cane. I drank it greedily after a period of sniffing and sampling, vowing, as I still do, that no coffee, however much it may be petted and coerced by white-capped chefs and nickel- or copper-plated percolators, has ever been so delicious.

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Joaquin da Silva, a halfbreed, penniless rubber gatherer, but the most human, charitable being I have ever met. He is prepared to go on a collecting tour. Note the small-headed hatchet for gashing trees, the gourd bucket, and the leaf-cups. Everything he uses he gets from the forest, or makes himself

My new friends and I became ac-

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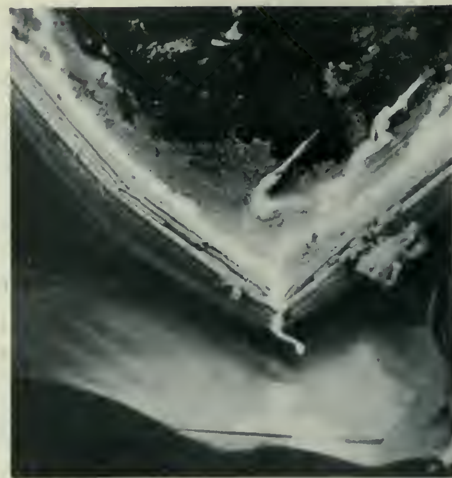

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(On the left) A rubber tree of the forest into which an incision has been made. The white latex is dripping into the leaf-cup attached at the lower point of the trough. The white gashes are the oozing milk

(On the right) Close view of the milk as it drips from the banding trough into the improvised leaf container where it collects until the native gathers it into his larger gourd. One hundred trees give a gallon of milk, which, when smoked, yields two kilos of rubber, for which the native collector receives about two dollars

quainted in a surprisingly short time. They told me that they had come from a little settlement up in Venezuela to spend a few months at their Brazilian home, where they had many wild rubber trees, the milk of which was already beginning to flow. The rubber-collecting season was setting in, and they said that in a few more days the river people would be exchanging habitations, each family going into sections where they had been accustomed to gather rubber and smoke it, or taking up new homes in areas on which they had discovered fresh trees. I thought probably that was the explanation of most of their wanderings. But it was not that entirely; there was much more to their roaming than the discovery of new trees. During the afternoon a canoe paused to exchange greetings. It was loaded, as customary, to the brim, and the stockily built man at the stern declared they were going to visit some friends on the lower river. They were carrying their household with them as they did not know when they might return. He might never return, he hinted, for he had heard that it was much pleasanter and easier to live on the lower reaches of the river—"Life will be sweeter there." They were in haste to be on their way, but they graciously agreed to wait until I wrote a letter to Senhor F—, an acquaintance who lived below the rapids, requesting him to come for me in his launch.

The natives, I believe, considered me as a novelty. I was a revelation to them just as they were to me. They sought to please and humor me in every way. I followed them over the small, hidden trails through the dark forest while they

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Forming hardened rubber around a pole over a dense acid smoke. Each layer of fresh milk hardens when it comes in contact with the smoke, increasing the size of the ball. This has all the properties of gutta-percha. The natives fashion bags, shoes, and other articles from it by hand

hunted or collected the thick, white milk from the wild borracha trees. At their hut I watched them smoke this liquid into large, dirty-looking balls, and even became expert in the operation myself.

Most of the articles about the home were made by hand from the products of the forest: the utensils were earthenware or gourds; nails were made by sharpening pieces of brittle palm mid-rib; fiber from the leaf of the tucum palm was twisted or braided into very strong cord (stronger than the silken fishing line I carried with me from the States). My hosts dressed, except at celebration times, in thin calico and often in rags, and ate farina cakes and what game and fish they were able to kill. But what there was they shared with me gladly and even attempted to give me more than my portion, or to deny themselves entirely, saying they did not like certain things which they saw I was very fond of.

Days merged into weeks. Gradually people crept up the river or drifted down it. Smoke was visible every afternoon, oozing up in thin, curling wisps from the forested shore, marking the spots where half-naked men squatted around a smoking flue and added layer after layer of white milk to a ball of rubber formed round the center of a short revolving pole. Two gaudily painted *batelaos* came, bringing *caxasa*, calico, and knickknacks, to be traded for rubber. One of them brought a note from Senhor F— announcing that as soon as he could arrange his affairs he would come for me.

With the arrival of *caxasa* on board the traders' *batelaos* there followed many gay periods of idleness and celebrations. *Caxasa* is a watery-looking liquid, made

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I think of the hospitality of the Caboclos as the greatest in the world. This native hut was given over to a party of explorers. The natives went down to the sandy beach to spend the night there

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Young girls returning from a local plantation with their canoe loaded with freshly dug mandioc roots. Bread made from these tubers is the staff of life for the people of the Amazon from sugar-cane juice, that can be diluted, so the story runs, if alcohol is added.

I was always invited to these celebrations, and upon my arrival invariably found a place of honor awaiting me—a new hammock usually, that had been stretched across a corner of the dance room. Then I learned another side to the vagabondage of these people. I remember one event especially. It was late in the afternoon and my Caboclo friends were busily cutting up and smoking chunks of peccary meat. Twenty-seven of these animals had been knocked over the head while swimming across the river earlier in the day, and, tied together like a raft, they had been towed ashore, much to the joy of everyone. Just as we were carving the last one, a long canoe appeared on the river and came crawling over the water on seven spidery legs as the paddlers splashed spray and thumped time against the sides. One of the men came up on the shore, while the others bathed in the river. "There is to be a *grande festa* at Sr. da Silva's, and he wants the *Senhor Americano*. He has sent us to bring him; will the *Senhor* please to come?" Yes, certainly the *Senhor* would, I responded with a smile, and went to my bag to get arrayed in my best. Over my worn-out breeches I pulled a pair of high boots which, sad to say, had been vigorously sampled on some previous night by an army of hungry saüba ants, the onslaughts of which had given each of the boots a sort of fringed appearance. A tight Norfolk hid my often patched but still torn shirt. I brushed my hair with my hands and parted it with my fingers, slipped on a stringy tie and put on my Stetson, the only article which was none the worse for wear, dirt, saübas, or rain. Then I was dressed.

I saw that each of the natives, besides having a paddle, had brought a musical instrument of some kind. There were three guitars, three smaller instruments like ukuleles, which they called *guavaquinos* and a worn-out remnant of a harmonica. The paddlers told me that the stringed instruments, save one guitar, had been fashioned by hand from rough blocks of unseasoned wood, with waxed strands of tucum palm for strings.

As we floated in the calm of the after-twilight the men began playing and singing. It was delightfully languid, drifting so upon the starlit stream. Other craft, with music and singing of their own and with little lamps burning in their bows, became visible on the dark waters. There was much of Venice in the atmosphere, and we floated happily along until we were greeted by a loud explosion on shore and turned in with yells and catcalls. They had set off a wad of gunpowder to welcome us. There were many visitors arriving. The women trudged silently to the large, thatched hut farther back in the fire-scorched clearing, while the men, who had been paddling, took baths in the river to refresh themselves, and dressed in their best clothes. They rubbed sweet-smelling vaseline into their hair and parted it sleekly. Then, in one awkward, uneasy group we went up to the place of celebration, where we were greeted by Senhor da Silva, a humorous little old man with grizzled hair and bow legs. He led me within the well-lighted room to a splendid hammock and graciously asked me if I would honor them by sitting there.

Like most parties it was a bit awkward and slow at first, but soon things began to liven up, and we all felt at ease. I sat like a congenial patron in my comfortable, swinging seat and watched all that went on. Coffee and wild pig broth was passed frequently to me, and *caxasa* to the other, more eager guests. Long, bark-wrapped, peculiar-smelling cigarettes, were smoked by all of us. When the rural music began, the men went to the women's side, grabbed partners by the hands, and led them into the middle of the room, then began gliding over the smooth, clay floor with graceful movements.

There were all classes of society in that swaying mass of happy people; all classes, that is, of Rio Negro society. I watched a woman with blue calico waist and full, pink ruffled skirt, whose blue-black hair was pulled back from her brown forehead and rolled Japanese-fashion in two puffs at the sides of her head, as she swung barefooted round in the crowd, as haughty and as graceful as any bejeweled lady of society. The little dandy with tight-fitting coat hitched in at the waist, whose hair had been plastered close to his narrow head by perfumed wax, pranced around with quick steps, clicking the wooden heels of his *chinelas* together rakishly. Even at this gathering, all the participants of which were dwellers in the jungle, the "hayseed" was present; awkward and lanky, he managed to keep going, watching his feet all the time, his round shoulders and long arms giving him a very loose-fitting aspect beneath his oversized garments. A little girl with pigtail and stiff pink dress seemed very happy in spite of the fact that she had to step lively and glance guardedly, in order that she might keep her naked toes from beneath the heavy soles of her youthful partner's sandals.

I did not dance; I only sat like a wise, old, abstinent owl and watched. Between dances *caxasa* and other liquids except water were passed to the guests. With the flowing of beverages a change came over the people. Usually, I observed, the traits manifesting themselves were the opposite to whatever characteristics were normally theirs. If most of the time they were all smiles and gaiety, they became sober, boorish, and with still more drink, brutish; if, on the other hand, they were habitually dull and sad-looking, they became gay and jovial. A drink of reverses it surely was!

Festivities kept up until just before the cold dawn. Then one by one the guests thanked their host and departed in their little canoes. Strangely I felt no need of sleep; I had been so well entertained. In the canoe with me the men gossiped with each other like little schoolboys returning from their first party, and, besides, seemed gleefully pleased at snug reminiscences of some dark-skinned maiden who, it seems, had danced with them all. I curled up in the bottom of the dilatory canoe trying to keep warm; the misty, early-morning chill that lay over the water was very penetrating. I had had a little glimpse into another side of their life, the fun and ease-loving side, which prompted them to move here and there in quest of *festas* and *caxasa*.

Three months had passed. Part of it had gone quickly, and part dreadfully slowly. Christmas and the New Year had come and gone, and at such times, if at all, one feels the ties that bind him to his native soil. There were many nights, I vividly remember, in which I found no sleep, but lay restlessly meditating while smoking many pungent cigarettes of black, native tobacco. Then, one evening after sunset, the awaited launch appeared. Senhor F— stepped out of it, and greeted me effusively, hugging me and patting my back.

When it came time to part with my Caboclo hosts, I held out my silver-handled hunting knife to the head of the house. "No!" he sharply exclaimed, "We want no pay for our *hospitalidade*. It is not sold. It has been a pleasure."

"But," I insisted, "such an insignificant gift as this is not *pay*—I mean you to accept it as a memento of an *Americano* who was very hungry."

They laughed happily. They were easily made to laugh, those river folk; little things made them happy and they would stop any work to listen to a good joke or to tell a mirthful story. Life as they knew it was very carefree. They passed my knife from one to another with shining eyes, and as I was getting into the tiny launch, the old man ceremoniously handed me a beautifully woven hammock of fine tucum, tasseled and prettily designed with white and black patterns. It was a valuable gift, for in Manaos my friends told me that it was worth every bit of seventy-five dollars. I thanked them as I took each by the hand, down to the smallest baby, and patted the envious, flea-bitten dogs that crowded excitedly at the water's edge. I was overwhelmed with gratitude to those people who had been so very kind to me and whom, I realized, I should probably never see again. Then I waved them a last farewell, and we chugged rapidly away downstream until they became mere specks, and then entirely disappeared.

The Portuguese gentleman who so hospitably carried me many miles through rapids to his large and comfortable villa on the lower river, where he fed me like a king on especially killed oxen, pigs, and chickens, and then carried me to Sao Isabel and put me on the little stern-wheeled steamer for Manaos, was only an elaboration of my previous hosts. He gave me more, simply because he had more to give. His industry had carried him away from their class, and he had no sympathy for people who, as he expressed it, came from nowhere and went nowhere, leaving nothing but rickety, thatched huts behind them. In some ways he was right; but he was not cognizant of the other side. In being so thoroughly practical he had missed, as so many others have missed, the deeper understanding of life that comes through a touch of sentiment. One of the ideals of life is to accomplish things, to amount to something; the other is to be contented while we live. We cannot always have both. These Rio Negro folk have few desires, and not being ambitious for worldly attainments, they live contentedly, experiencing none of the heartaches which come so often to those with larger aims. They are dwellers in a land where great physical efforts are unnecessary. A few holes punched in the ground, and shoots of mandioca bushes inserted, will soon yield large, tuber-like roots which may be ground and cooked into hard, life-giving bread. Fish are in the waters and game in the woods, and the palm trees provide excellent thatch for shelters.

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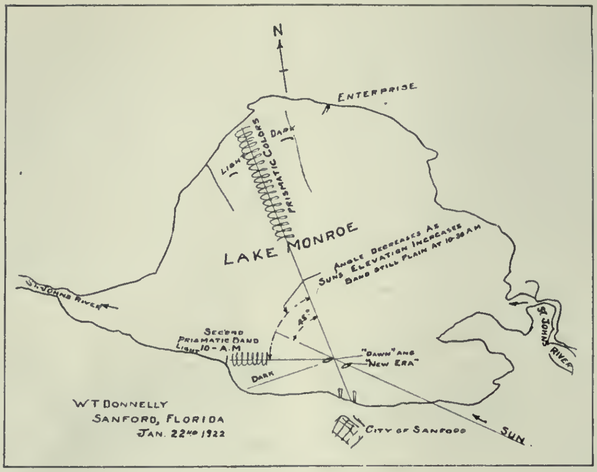
Future Amazon

If these people work a few months each year, they can buy, with the rubber they have collected and smoked from the wild rubber trees, cloth for clothing, some tobacco, ammunition, and more *caxasa* than is good for them. The thought that came to me so often was not how lazy they seemed, but how happy and contented they were with life as it was allotted to them.



AN OPTICAL PHENOMENON ON A FLORIDA LAKE

BY

WILLIAM T. DONNELLY

NOTE.—The article that follows represents the contents of a letter written by Mr. Donnelly under date of January 22, 1922. In a later letter he states that on two subsequent occasions he saw the phenomenon repeated.

MY YACHTS, "Dawn" and "New Era," are anchored in Lake Monroe, Florida, off the city of Sanford at the head of navigation on the St. Johns River. Lake Monroe is approximately $4\frac{1}{2}$ miles long by $3\frac{1}{2}$ miles wide; the St. Johns River enters at one end and leaves from the other. This morning when I came out on deck soon after sunrise, I noticed toward the east a remarkable phenomenon on the water. A band of prismatic colors, familiarly known as the rainbow, seemed to extend on the water, commencing about one third of the way across the lake and reaching to the shore. The atmosphere, while hazy, was in no sense foggy, and the sun was shining brightly. This phenomenon persisted and at the present time, 9.30 A.M., is truly remarkable. The haze has almost entirely disappeared. The lake is perfectly calm. The band of refracted light seems to be much broader than the usual rainbow phenomenon.

It occurred to me to measure roughly and record the angular relation of the prismatic band with the sun, and the most ready way of doing so was to take two triangles, sighting along one pointing to the prismatic path on the water and laying the other triangle across it. The result was so geometric as to be almost startling. It will be noted from the sketch that the angle formed by the projection of the sun's rays as compared with the path of the refracted light is an angle of 45 degrees. It was perfectly simple to adjust these angles by sighting down the long side of the 45 degree angle and holding up a finger and adjusting the 60 degree angle until the shadow ran along its edge.

To me the remarkable fact about the phenomenon is its persistency and the brilliance of the refraction all the way across the prismatic scale; an added phenomenon is a very pronouncedly dark band to the right, or orange end, of the spectrum, and a bright band on the left, or purple end.

About breakfast time a young native paddled by in his canoe. When I asked him what he knew about the phenomenon, he replied that the rainbow was present every morning when the lake was calm. . . .

Since writing the above, the other end of the rainbow has appeared, relatively as noted on the sketch. It is even more brilliant than the first—in fact, the most brilliant prismatic scale and the most extended that I have ever seen. It is now past ten o'clock; almost every particle of haze has disappeared from the lake, but still the prismatic band persists. At this writing, the tender of the "Dawn," rowed by my daughter, is sailing down this band. Surely it is a land where one can chase the rainbow and, it would almost seem, with some prospect of capturing it, so close and friendly it appears to be.

NOTES

THE ENDOWMENT FUND OF THE AMERICAN MUSEUM

The Gift of Mr. George F. Baker.—Since the last issue of Natural History went to press several gifts of unusual magnitude have been made by public-spirited citizens to the Endowment Fund of the American Museum. It is the hope of the Trustees that during the present year at least $2,000,000 may be raised for this fund—an amount which is sorely needed if the Museum is to maintain the practical service which it is rendering to science and to education. The munificent sums donated thus far will encourage the Trustees in their unremitting efforts to see this hope fulfilled.

The initial subscription to the fund was made by Mr. George F. Baker, ever a loyal friend of the Museum, who contributed the sum of $250,000, the income from which is to be used as the Board of Trustees may determine. At a meeting of the executive committee of the Board, held on June 21, 1922, the following resolution was passed:

"*BE IT RESOLVED*, That the Trustees desire to record their deep sense of gratitude to Mr. Baker for his generous gift of $250,000, which constitutes the initial contribution to the much needed enlarged Endowment for the growth and development of the Museum. The Trustees deeply appreciate not only the intrinsic value of the gift, but especially the generous attitude of the donor in permitting the unrestricted use of the income of this fund—an action which is indicative of his confidence in the administration of the Museum and the aims and purposes of the institution. In recognition of Mr. Baker's earlier contributions, the Trustees have previously elected him a Benefactor and can therefore merely express their gratitude to him by extending their heartfelt thanks and best wishes for continued good health and happiness."

The Gift of Mr. John D. Rockefeller, Jr.—On June 17 Mr. John D. Rockefeller, Jr. presented the American Museum with securities valued in excess of $1,000,000. In a letter ot President Henry Fairfield Osborn, announcing this generous gift, Mr. Rockefeller stated that he had long felt that the American Museum was playing an important part educationally and otherwise in the life of New York City—an impression that had been confirmed by a careful study of the Museum which he had recently caused to be made. Mr. Rockefeller expressed the hope that the sum of $1,000,000 might be set aside for permanent endowment, the income therefrom to be applied to the current needs of the Museum. He added, however, that he realized the unwisdom of seeking to forecast the requirements of the distant future, and that he was fully conscious of the dangers attendant upon the establishment of any endowment fund in perpetuity. Accordingly it would be agreeable to him, if at any time the Trustees deemed such a disposition to be in the best interests of the Museum, to have the whole or any portion of the principal of the gift devoted to any of the corporate purposes of the Museum.

In acknowledgment of Mr. Rockefeller's contribution, the Trustees passed the following resolution:

"*RESOLVED*, That the Trustees accept with grateful thanks the splendid gift of $1,000,000 presented to the Museum by Mr. John D. Rockefeller, Jr. for its corporate purposes and hereby take pleasure in applying it to the Permanent Endowment Fund, the principal to be kept invested and the income only to be expended for the work of the institution.

"This munificent gift, valued at more than a million dollars, is the more appreciated because it is received at a time when the increase of the Permanent Endowment by at least $2,000,000 stands as the paramount need of the Museum, in order that its scientific exploration and research may not be curtailed and in order that it may continue to render to public education, especially through the school system of the City and Country, a service which is increasing in importance and is receiving the universal approval of educators.

"Mr. Rockefeller's attitude in his generous terms of gift and in his liberal-mindedness with respect to the use of this fund is a further source of deep satisfaction and encouragement to the Trustees because it indicates his hearty endorsement of the aims and purposes of the Museum and of the Trustees' policy in its development and expresses his belief in the present and future service which it can render to science and education for all the people.

"In recognition of Mr. Rockefeller's interest in the Museum, the Trustees take pleasure in hereby electing him a *Benefactor*."

The Amos F. Eno Bequest.—The Museum also receives, under the terms of settlement of the contested will of the late Amos F. Eno, the sum of $272,000, of which $250,000 is to be added to the Endowment Fund.

ALBERT I, PRINCE OF MONACO

Albert I, Prince of Monaco, who died in Paris on June 27, at the age of seventy-four, was known the world over for his studies in oceanography, to which he devoted most of his spare time and much of his fortune. In yachts especially constructed for marine research, including successively the "Hirondelle," the first "Princesse Alice," and the second "Princesse Alice," he investigated the life of the seas and studied the ocean currents over an area extending from the tropics to the Arctic. He developed many new appliances for deep-sea dredging, and devised an electric lamp which when lowered to the black, sunless depths of the ocean, served as a bait to attract the fishes that live far below the surface. He added greatly to our knowledge of the distribution of the fauna of the seas, in addition to discovering many species new to science. The results of his researches were made known to the world not only through detailed publication but through the oceanographical museums which he established at Monaco and Paris.

With all his keen interest in marine research, he was also the liberal patron of other branches of science. In 1910 he wrote to the Minister of Public Instruction in Paris that in the course of his active life he had often regretted that a larger place had not been assigned in the intellectual movement of the day to studies tending to clear up the mystery enveloping the origins of humanity. To the end that such studies might receive more attention, he proposed the founding of the Institut de Paléontologie humaine, an institution which, generously endowed by the Prince, has become one of the leading agencies in contributing to our knowledge of early man.

It is only a little more than a year ago since the Prince of Monaco visited this country, where he lectured before various scientific bodies and was the recipient of many honors. On a previous visit the Prince had lectured before the American Museum and had made a tour of that institution, examining its exhibits with interest and expressing his cordial approval of the proposal to add to the Museum a hall of oceanic life, a project recently made possible through the generous action taken by the Board of Estimate and Apportionment in authorizing sums for the erection of a Southeast Court, which is to be given over exclusively to exhibits of marine life.

THE THIRD ASIATIC EXPEDITION

Progress of the Expedition to Mongolia.—In a letter written from Urga Mr. Roy Chapman Andrews, leader of the Third Asiatic Expedition, which the American Museum is conducting in coöperation with the American Asiatic Society and with *Asia*, informs President Henry Fairfield Osborn that the expedition left Kalgan on April 21. For about 250 miles the automobiles were run rapidly, but the rate of progress did not prevent the geologists in the party from making scientific notations regarding the region covered. Half way across Mongolia, between Kalgan and Urga, interesting exposures were observed, and here the party camped. Mr. Walter Granger, the palæontologist of the expedition, and the geologists found fossils immediately and so promising did the locality seem that Mr. Granger, Professor Charles P. Berkey, and Mr. Morris remained to explore the site more thoroughly when the rest of the party under Mr. Andrews pushed on to Turin, 152 miles south of Urga, where they hoped to find their caravan. Incidentally it may be said that this fossil locality proved to be of unusual importance, containing specimens of Cretaceous, Eocene, and Miocene age.

"We reached Turin without accident," writes Mr. Andrews, "and as we ran up the road, saw a great caravan and camped a few yards away. Then I suddenly saw the American flag and realized that it was our caravan. They had arrived just an hour before us, having been five weeks on the way from Kalgan. Pretty fine connections for a 700 mile journey across the plains, was it not? We went over to the great rocky outcrop and pitched our tents. The caravan arrived an hour later. It was an inspiring sight as the 74 camels wound up from the plain, with the American flag at the head. It made me realize, as nothing else has, that the expedition was really an accomplished fact, that all the nerve-racking work had resulted in this. It was a dream come true. Shackelford recorded it all in motion pictures from the moment the camels came into the rocky pass, until they lined up in three long rows and kneeled to have their loads removed."

That the party of explorers is by this time thoroughly seasoned may be gleaned from a paragraph in a recent letter of Professor Berkey:

"Desert life is strenuous but we are all standing it. We have already learned to wash only as often as the natives do and on the whole we do not look much unlike them. We have learned to eat sand with more or less relish in all kinds of food and to sleep peacefully with the chill winds simply sweeping through the tent and threatening to blow the flimsy-looking, ballooning thing into the Sea of Japan. Judging from the amount of wind that has come this way in the last week, there ought to be a great scarcity of atmosphere somewhere."

AMPHIBIANS AND REPTILES

The Heilprin Expedition to Santo Domingo.—In the projected Southeast Wing of the American Museum the third floor will be reserved as a hall of recent reptiles, animals the many-sided interest of which cannot be adequately indicated in the limited space at present available in the Museum. To secure two groups of unusual character for this new hall is the major purpose of the Heilprin Expedition, which under the leadership of Dr. G. Kingsley Noble and Mrs. Noble, of the American Museum, sailed on July 26 by the S. S. "Iroquois" for a sojourn of three months in the Dominican Republic. Although the West Indian region as a whole is rich in reptilian and amphibian life, it is in Santo Domingo, and nowhere else, that are found two of the most spectacular creatures of the archipelago. These are the rhinoceros iguana, *Cyclura cornuta*, and the giant tree frog, *Hyla vasta*.

The former is a formidable-looking lizard that attains a length of as much as four feet and has on its snout a horn about one inch in height. It is extremely muscular, with big head and heavy jowls. It stands with its legs bent, bull-dog fashion, and when cornered, will face its pursuer, open its large mouth, and dart out its red tongue with blue-black tip, presenting an aggressive, even a terror-inspiring appearance. In its ways of life—in so far as these are known—it is not less interesting. In contrast to the true Central American and South American iguanas, which are semi-arboreal, semi-aquatic, taking to the water readily when disturbed, the rhinoceros iguana is terrestrial. Its habitat today is chiefly in the arid southwestern portion of Santo Domingo, in the vicinity of a dead sea, the surface of which is more than a hundred feet below sea level. There it lives in burrows, which presumably it digs itself.

Although our knowledge of the rhinoceros iguana is incomplete, much less is known about the other creature of the search, the *Hyla vasta*, the largest and most spectacular tree frog in the world. Only three specimens of this batrachian have been taken thus far. The locality of the type specimen has not been recorded. The other two specimens were found by the veteran naturalist, Dr. W. L. Abbott—one in the Central Cordillera, the other on the Quita Espuela, a range of mountains in the northeastern part of Santo Domingo. The expedition, which will make an intensive search in the latter region, hopes to secure valuable scientific data bearing upon this frog, in addition to exhibition material. Dogs will probably be used in tracking and cornering the iguana, and full photographic equipment is being taken on the trip for the purpose of recording the behavior of the living animals. A supply of snake bags provided for the expedition suggests another activity incidental to the two main purposes.

Reptiles and Amphibians Collected by the Third Asiatic Expedition.—A shipment has been received at the American Museum consisting of reptiles and amphibians collected by the Third Asiatic Expedition, which the American Museum is conducting in coöperation with the American Asiatic Society and *Asia*. This shipment, the specimens of which are in unusually good condition—the colors of life, even the delicate pinks, being remarkably well preserved—includes 576 frogs and toads, 46 turtles, 170 lizards, 6 salamanders, and 181 snakes. The snakes will immediately engage the attention of Mr. Arthur Ortenburger, who has accepted the position of assistant curator in the department of herpetology vacated by Mr. Karl Schmidt, who has left the Museum to take charge of the reptile department at the Field Museum, Chicago. Mr. Ortenburger, fellow in zoölogy during the past two years at the University of Michigan, and prior to that teaching assistant in that institution, is an authority on the genus *Coluber*, a genus that includes the true black snakes and the racers, and the results of his examination of the Chinese snakes, which show some affinities to those of eastern North America, will be awaited with interest.

MAMMALS

To the Memory of Joel Asaph Allen.—The brief reference to a man's life inscribed on his gravestone is but one of many entries in a community of the dead. It is read by those who, with a feeling of detachment from the world, visit the resting place of those who have gone beyond recall from their several spheres of activity. Rarely does it fall to the lot of a man to have his memory associated for all time in an ineradicable manner with the interests that engaged his energies. Yet those who visit the North American mammal hall, now rechristened Allen Hall, and view the tablet of bronze with its fine portrait of the late Dr. Joel Asaph Allen, will always be reminded that the department of mammalogy of the American Museum owed its development to him, having for more than thirty-five years benefited by his devoted labors. In dedicating the hall to Dr. Allen's memory, President Henry Fairfield Osborn and the Trustees of the Museum performed a deed for which the scientific staff feel deeply grateful, and at a recent meeting of the division of zoölogy a motion was made and passed that the thanks of the division be conveyed to the President and the Trustees for their recognition in this signal manner of Dr. Allen's services.

A Trip to British Guiana.—Herbert Lang, assistant curator of African mammals, will leave in September for British Guiana, returning to the American Museum toward the beginning of December. At Georgetown he will join Mr. William LaVarre, whose article on the Caboclos appears in this issue. Proceeding with him up the Essequibo River and continuing through the diamond mining district along the Mazaruni, Mr. Lang hopes to go beyond the forest to the savannah country and Mt. Roraima. This trip will afford an excellent opportunity for a comparative study of ecological conditions in the South American forests and savannahs with those in equatorial Africa. Such a first-hand comparison has been a long-felt want in connection with the preparation of certain reports on the American Museum Congo Expedition, of

Photograph by Joseph Brown & Son of Milwaukee

At the Zoölogical Garden in Milwaukee a moat-surrounded "monkey mountain" has been constructed, with trees for the animals to climb, a beach on which they may disport themselves, and a cave that offers a shelter from the winds. The "mountain" is an attraction not only for the monkeys but for a host of spectators

which Mr. Lang was the leader. Photographic work will be one of the chief features. A visit is also contemplated to Director William Beebe, of the New York Zoölogical Society's Tropical Research Station at Kartabo. The zoölogical collections that Mr. Lang will make are to be presented to the American Museum.

A "Monkey Mountain."—The Zoölogical Garden in Milwaukee, Wisconsin, possesses a unique feature in its "monkey mountain," located on an island. Mr. Edward H. Bean, the director of the garden, believes it to be different from anything that has been attempted in America. He has given an interesting description of it in the journal, *Parks and Recreation.*

The Park Commissioners of Milwaukee, realizing that monkeys entertain and hold the attention of visitors to the Zoölogical Garden longer than any other exhibit, erected an oval-shaped mound, suggestive of a mountain, 127 feet long and 82 feet wide, where the monkeys may be viewed under as nearly natural conditions as possible. On the south side of the mound a concrete cave was constructed, 7 x 9 x 7 feet, with an alcove facing south. This gives a large open space, protected from the north, west, and east winds in the early spring and late fall. At one end of the mound are a series of rock shelves about 4 feet wide, upon which the monkeys disport themselves and where they also receive their food.

From the highest point on the mound a rivulet flows, winding its way westward over rocky precipices to a moat below. Where it terminates is a fairly extensive sand beach, on which the monkeys can bask in the sun. The entire surface of the mound, with the exception of the sand beach, is sodded. Norway maple, Austrian, Mugo, and white pine, and arbor vitæ trees were planted as well as some memorial roses. The moat surrounding the mound is 30 feet wide; on its outer side a wall has been so constructed as to prevent the escape of the monkeys should any attempt to swim across the moat.

The species of monkeys given their liberty on this delightful island are golden baboon, hamadryas baboon, rhesus, common macaque, Japanese red-faced and pig-tailed monkeys. These get on well together and are very active and amusing to visitors. The place is so arranged that it is possible for four thousand visitors to enjoy the interesting antics of the monkeys under natural surroundings.

THE ISLAND OF MALTA

Grooves of travel, traversed year after year by successive groups of tourists, tend to wear deeper and deeper, forcing the annual stream of sight-seers to follow the established channels. Yet not far beyond the much-visited places—sometimes, in fact, ridiculously close to them—are spots that in spite of the interest they offer are comparatively neglected. Such a spot is the island of Malta, which, although only eighty miles south of Sicily, has been excluded from itineraries that have embraced Mediterranean ports of less appeal.

Great is the historic interest of Malta, which was successively occupied by the Phœnicians, the Romans, and the Moors, and which in the sixteenth century under the Knights of Malta was the doughty defender of the faith against the Turk. A still earlier phase of its history than any of those just mentioned is that represented by its Neolithic monuments, and readers of NATURAL HISTORY who have had their interest in early European man stimulated through the series of articles contributed to recent issues of the magazine by Professor Henry Fairfield Osborn may to advantage include Malta and the adjoining island of Gozo among the places to be studied. There are several megalithic buildings of the Neolithic period in Malta and Gozo and numerous minor evidences of the occupation of these islands by prehistoric man. Polished stone pendants, figures of stone and of earthenware, objects of flint, of native limestone, of bone, of clay, and of shell, votive axes, hammers, mortars, and other implements, vases of different wares and forms, are among the treasures that have been recovered from these ancient sites, and many of them may be viewed at the Valletta Museum, the curator of which, Dr. T. Zammit, has through his publications, written both singly and in collaboration with others, thrown interesting light on the archæology of Malta.

Lest it be inferred that the attractions of Malta are limited to those stressed in the previous paragraph, mention should be made that in a recently issued booklet on the *Ichthyology of Malta*, Mr. G. Despott alludes to the fact that no less than 272 fishes are found in the waters surrounding the islands.

It is the earnest hope of the Honorable Mason Mitchell, the American Consul at Malta, whose keen interest in science is evidenced in part by his valuable gifts of specimens to the American Museum, that his fellow citizens in the United States may become cognizant of the attractions of Malta and may thereby be induced to view with their own eyes its excavated sites, the picturesque beauty of its palaces, its bastions and fortifications, and the quaint dress and customs of its natives.

EUROPEAN ARCHÆOLOGY

FOSSIL MAN IN SPAIN.—Le Comte de Bégouen has recently issued a biographical sketch and appreciation of Émile Cartailhac, the great French archæologist whose death was reported in a recent issue of NATURAL HISTORY (January-February, 1922, p. 93), in the course of which he records a striking instance of Cartailhac's devotion to the truth:

Photograph by Joseph Brown & Son

A section of the "monkey mountain," with a few of its denizens

"Cartailhac was one of the first to concern himself with the prehistory of Spain. His beautiful and very rare work on the *Prehistoric Periods of Spain and Portugal* had opened the way to research of the peninsula. He had extended his explorations to include the subject matter presented in *Megalithic Monuments of the Balearic Isles*, and having for a long time been the prime mover in the study of prehistoric Spain, held a predominant position as an authority in this field.

"When M. de Santuola announced that he had discovered on the ceiling of a grotto in the environment of Santander certain prehistoric paintings, Cartailhac was skeptical and all the learned world ranged itself with him, casting doubt on the discovery of M. de Santuola. But as time progressed, one discovery succeeded another. Here and there were noticed on the walls of grottoes traces of black or red. The revision of a case too hastily judged was encumbent. Cartailhac left for Altamira; he saw and was convinced. He published immediately in

Anthropologie—the review which had succeeded *Matériaux*—under the title of "The *mea culpa* of an Anthropologist," an article in which he publicly confessed his error. Furthermore, with that ardor which was characteristic of him, he took up enthusiastically the study of these fine prehistoric paintings, from which study resulted, thanks to the generosity of the Prince of Monaco, that fine work on Altamira which is the initial volume in the splendidly illustrated series devoted to the decorated caves."

Magic, the First Motive of Art.—Another paragraph from the biographical sketch of Cartailhac will be of particular interest to those who, through the article contributed by Professor Henry Fairfield Osborn to the January-February issue of Natural History (pp. 27–41), have been made acquainted with the figure of the sorcerer found in the cavern of Les Trois Frères and the engraving of a similar figure discovered on a piece of schist rock in the grotto of Lourdes:

"The discoveries [of paintings] that followed one another in the grottoes of France and of Spain gave rise to the problem of the origin of this art. Taking his cue from what we know of the mentality of primitive peoples Cartailhac accepted the hypothesis of the magic origin of art. All the arrows carved or painted upon the animals represented were missiles of enchantment which on the eve of a hunt were mysteriously delineated in the most inaccessible and remote recesses of the grottoes in order to cast a spell upon the animal to be hunted. 'We are in the cave of the sorcerer,' he wrote from Marsoulas to M. Salomon Reinach and deep was his joy when we showed him under the bizarre masque the human face that is represented in the final chamber of the cavern of Les Trois Frères,—a divine spirit or a sorcerer dominating the numerous animals so skilfully represented beneath him.

"I have said that I would not analyze the scientific work of Cartailhac; I shall not speak therefore of his publications; I shall not enter into the details of his researches regarding certain points of chronology, especially regarding the Aurignacian period or the cut flints of the grottoes of Grimaldi. I shall not awaken the echo of certain scientific controversies that were at one time very intense. Time has softened them, in vindicating generally the keen and circumspect intellect of him who was my master and my friend."

Prehistoric Spanish Art.—The exhibition of prehistoric Spanish art organized and carried to completion under the auspices of the Sociedad española de Amigos del Arte, claims attention as the first of its kind to be held anywhere in the world. It is fitting that an exhibition of this character should have had its inception in Spain, a land which enshrines within its caves so many impressive examples of the art of Palæolithic man. The exhibition, an account of which appears in a handsomely illustrated pamphlet from the pen of D. Eduardo Hernández-Pacheco, consisted principally of copies of paintings and sculptures the originals of which are scattered throughout Spain, almost all of the localities of prehistoric interest being represented. Accompanying these copies were photographs of the sites, caverns, and rocks where the originals are located and photographs of the art objects themselves, besides diagrams of the caverns and maps showing the distribution of the prehistoric pictures in Spain. In glass cases were arranged utensils, arms, objects of ornament, and the like, illustrative of the degree of civilization attained by the people who made the paintings and serving also to indicate the period of their production.

The Antiquities of Roman Britain.—We often need to be reminded that England was once a Roman province, traversed by magnificent Roman roads, protected by fortifications and walled camps. The tracing out of these ruins, the study of the many pottery, bronze, gold, silver, and even iron objects found in the ground and even in the beds of rivers enriches the archæology of Britain. A rich collection of these materials is now housed in a special room of the British Museum under the keepership of O. M. Dalton and a handbook under the title, *A Guide to the Antiquities of Roman Britain in the Department of British and Mediæval Antiquities*, containing 13 plates and 142 illustrations, has just been issued describing these archæological treasures.

LOWER INVERTEBRATES

Destroyers of Wharf Property.—Great damage, amounting in the aggregate to several millions of dollars, has been wrought to the wharf property in San Francisco Harbor in recent years by the "shipworm," a marine mollusk, the soft body of which becomes long and wormlike when adult, while the shell remains quite small and is transformed into a burrowing apparatus. The shell is double and, in the young, is somewhat like that of a small clam, but in the adult it is furnished with rows of teeth, by means of which the animal drills into wooden structures, feeding upon the wood as it does so. Wharf piles, into which a number of these creatures have penetrated, become in time mere shells, honey-combed with burrows and, when they collapse, carry down with them the structures that have been reared upon them.

For some reason New York Harbor has been comparatively immune from the ravages of the "shipworm" although the animal has been found in the Lower Bay as well as in Long Island Sound as far as its junction with the East River. The increased damage done in San Francisco Harbor within recent years occasioned the fear, however, lest similar injury might be inflicted upon the wharf property, valued at millions of dollars, along the New York water front. Accordingly, through the initiative of the National Research Council a committee was called into being early in 1922, consisting of forty-three engineers, chemists, and biologists, and including Dr. Roy W. Miner, curator of the department of lower invertebrates at the American Museum, and Dr. H. E. Crampton, until recently honorary curator of that department.

Although it is to be hoped that New Yorkers may be spared an extensive acquaintance with the living animal, they may familiarize themselves innocuously with its workmanship through a visit to the American Museum where, in an exhibit in course of completion, are shown wharf piles damaged by the shipworm and by *Limnoria*. The latter is a very small wood louse belonging to the group Crustacea, which also includes the shrimps and the crabs. *Limnoria* attacks the wood near the low water mark in large numbers and rapidly devours it. The burrows of the shipworm, on the other hand, seem to be most numerous on the part of the pile nearest the sea bottom.

Dr. H. W. Stunkard, Research Associate.—Dr. Horace W. Stunkard, instructor in biology at New York University, was recently made research associate of parasitology in the department of lower invertebrates, American Museum. Dr. Stunkard is thoroughly experienced in the modern technique of this most difficult subject of research. He has already published several noteworthy papers on blood flukes and is engaged upon a monograph on the blood fluke parasites. This subject is very important from both an economic and a phylogenetic standpoint, as it tends to demonstrate that the evolution of these parasites has kept pace with the evolution of the higher vertebrates from lower types.

Captain Frank Potts.—A distinguished biologist from Cambridge University, England, Captain Frank Potts, visited the American Museum on his way to the Marine Laboratory of the Carnegie Institution at Tortugas, Florida, to complete investigations begun some years ago in collaboration with Dr. Alfred Mayor, the director of the Marine Laboratory, whose brilliant career was recently terminated prematurely by death.

INSECTS

The Little-Changing Ants.—Dr. William Morton Wheeler, research associate of social insects, American Museum, points out in the first of his Lowell Lectures, printed in the June issue of the *Scientific Monthly*, that "the ants have undergone no important structural modifications since the Lower Oligocene, that they had at that time developed all their various castes just as we see them today, that their larvæ and pupæ were the same, that they attended plant-lice, kept guest-beetles in their nests and had parasitic mites attached to their legs in the very same peculiar positions as in our living species, and that at least six of the seven existing subfamilies and many of the existing genera were fully established." Dr. Wheeler is in a position to speak with full confidence because he had the opportunity some years ago of examining no less than 9,560 specimens, representing 92 species and 43 genera, from Lower Oligocene time. These insects had been trapped in the liquid resin that exuded from the pine trunks of that period and that later hardened. In this transparent medium, known as Baltic amber, insects are exquisitely preserved and offer exceptional opportunities for study.

An Entomologist Wins Linnean Society Medal.—The gold medal of the Linnean Society of London, which is given alternately to a botanist and a zoölogist, was this year bestowed upon Professor E. B. Poulton, the well-known entomologist, at the anniversary meeting on May 24.

A Veteran Coleopterist Honored.—Mr. Eugene A. Schwarz, honorary custodian of Coleoptera in the United States National Museum, was the recipient of the honorary degree of doctor of science at the commencement of the University of Maryland, on June 10.

Leaf-Cutting Bees and Their Relatives.—Through the kindness of Mr. William M. Savin we are able to publish a supplement to the article about the leaf-cutting bee and to the illustrations of its workmanship that appeared in the May-June issue of Natural History, pp. 250–57. The studies of this bee which Mr. Savin has been continuing this summer have yielded, like those of the previous year, interesting observations the value of which is enhanced by the superb photographic records which he has made. He writes of his work this summer as follows:

"New boards[1] containing nine burrows were put out to attract the bees and during the last few days of May the insects commenced to build their nests. One interesting feature of their work was that while there were old-fashioned single-rose bushes directly under the nests and

[1]For a description of the general character of these boards the reader is referred to the May-June issue of Natural History, p. 252.

Photographed by William M. Savin

On the left *Megachile brevis*, builder of the lowest nest shown on the opposing page. On the right the *Osmia* that appropriated the shaft in which a *Megachile* had laid the foundation cell of her nest (see opposing page)

many of the leaves of these were fairly riddled by the removal of clippings, some of the bees went afield to secure cuttings. However, the *Megachile brevis*, the picture of which appears above, secured material for her nest from those bushes and frequently bees building elsewhere came to visit them for cuttings. Some *Megachile* were very rapid workers, snipping pieces in ten seconds, others worked very methodically and required twice as long.

"A bee of another genus was engaged in nest-building in one of the burrows. She was captured and found to be an *Osmia*. On uncovering the cells built by this *Osmia* it was discovered that she had preëmpted a *Megachile* nest ofter one cell had been completed by the leaf-cutter. The intruder's nest contained four cells, each one stocked with a pill of food consisting of nectar and pollen for the grub to feed upon when emerged. Partitions of dirt cemented with saliva divided the cells."

ALFRED GOLDSBOROUGH MAYOR

Dr. Alfred Goldsborough Mayor, director of the department of marine biology of the Carnegie Institution of Washington and a member of the American Museum, died in his laboratory at Tortugas on June 24 at the age of fifty-four years. In spite of the fact that he was weakened by a two years' fight against tuberculosis, he insisted upon opening the Tortugas laboratory for the season and was actively engaged in supervising the work there when the end came.

Doctor Mayor was a remarkable man in more than one line of scientific work. The son of the distinguished physicist, Prof. Alfred M. Mayor, he himself was brought up as a physicist and served as assistant in physics for a year each at Clark and Kansas universities. In keeping with this training, among his other accomplishments, he was an excellent navigator, and during the great war he taught navigation to hundreds of young men at Princeton University, writing for this course a short and simplified text which has been pronounced the best of its kind ever published.

After varied service as assistant to Alexander Agassiz on the "Albatross" and in the Museum of Comparative Zoölogy, Doctor Mayor was curator-in-chief of the Brooklyn Museum, 1900–1904, and then went to the Carnegie Institution to spend the remainder of his life in its service.

As a zoölogist, Doctor Mayor was prominent in several lines of investigation. As a systematist, an evolutionist, and especially a physiologist his work will long endure. His largest contribution to science is his great three-volume work on the *Medusæ of the World*, illustrated with his own paintings, for among his other accomplishments he was a zoölogical illustrator of distinction.

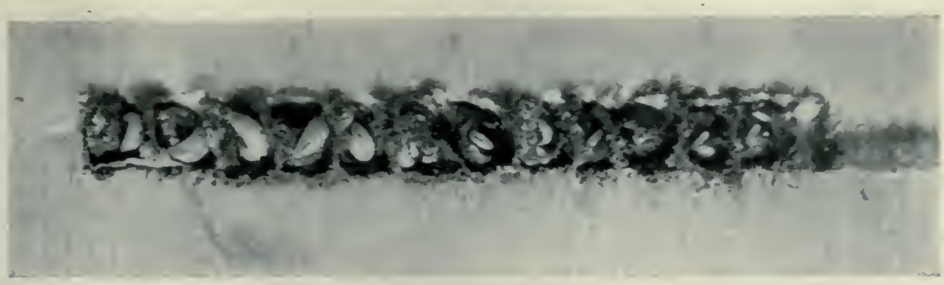
As the leader of scientific expeditions and director of marine laboratory work Doctor Mayor was without a peer; but those who have gone on these expeditions or have enjoyed the hospitality of the laboratory of the Carnegie Institution at Tortugas will always think of Doctor Mayor not only as a great zoölogist but also as a big-hearted, kindly, square-dealing gentleman.—E. W. Gudger.

FISHES

The Miami Aquarium and Laboratory.—During the winter and spring months (January to April, 1922) the Miami Aquarium and Laboratory, an account of which, written by Mr. John Treadwell Nichols, appeared in the issue of Natural History for July-August, 1921, pp. 356–66, was visited by upward of 70,000 people and its officers were in receipt of hearty words of praise and congratulation from the many who were impressed by the exhibition. During the summer and fall the Aquarium will be closed as it has been found through past experience that the attendance during that portion of the year is not sufficient to justify the heavy maintenance charges involved. The rare specimens have been placed, until the institution is reopened, in especially constructed "cars"—floating boxes to which the water penetrates freely—in Biscayne Bay, and are being watched over and fed by attendants detailed for that purpose. Less precious specimens have been made available to other aquariums. There will be no difficulty in replacing these specimens by others of the same or equally interesting species when the proper time arrives, for a careful survey has been made of the haunts of the many varieties of fish shown and to be shown, with the result that the collecting boats will be able in four weeks' time entirely to restock the tanks.

BIRDS

Hawaiian Birds.—In exchange for duplicate specimens of birds taken by the Whitney South Sea Expedition, the American Museum has received from the Bernice Pauahi Bishop



Photographed by William M. Savin

The topmost nest, consisting of twelve cells stocked with food, is that of an *Osmia* bee. In each cell the mother has laid an egg. Eight of these eggs have already hatched and the larvæ may be seen. The partitions between the cells are built of chewed pieces of leaf cemented with saliva. Some other *Osmia* mix a few scrapings of pith with this green paste; still others build their compartments solely of mud.

The middle nest is of interest because it shows that an *Osmia* preëmpted the shaft in which a leaf-cutting bee, *Megachile*, had begun to build. The long cylindrical cell is that of the leaf-cutter; the four shallow cells those of the *Osmia*.

A completed nest of *Megachile brevis* occupies the lowest shaft. A picture of this nest builder may be seen on the opposing page

Museum of Honolulu a collection of birds from the Hawaiian Islands and from the islands to the west and south of this group that could not be duplicated from any other source. The collection, consisting of several hundred skins, comprises very nearly the complete avifauna of Hawaii. Among the specimens are not a few rare and extinct forms. Some of the birds are of historic interest because of the fact that their yellow and red plumage was used in the cloaks and helmets of the Hawaiian chiefs. Feathers of native birds were used also for the *leis*, or ruffs, worn about the head or the neck and in the hair, and for the ornamentation of the *kahilis*, or poles, that early in the history of the Hawaiians became symbols of rank, the larger ones being carried in the funeral processions of the great. Among the birds that furnished feathers for one or another of these purposes were: the bright red iiwi (*Vestiaria coccinea*), formerly the most abundant native bird but now like all the indigenous species much reduced in numbers; the oo (*Acrulocercus nobilis*), of brilliant black plumage with yellow tufts in sharp contrast, a bird found only on the island of Hawaii; the beautiful mamo (*Drepanis pacifica*), now nearly extinct if not actually so, the name of which has been applied to all royal war-cloaks.

An Honor Conferred upon Dr. R. C. Murphy.—At the meeting on May 26 of the Sociedad Ornitológica del Plata in Buenos Aires, Dr. Robert Cushman Murphy, associate curator of marine birds, American Museum, was elected a corresponding member. The distinction of honorary membership or of corresponding membership in this, the leading ornithological society of South America, has been conferred upon few individuals. Only one other American, Dr. Ridgway of the National Museum, shares with Dr. Frank M. Chapman the rank of honorary membership; Doctor Murphy is the fourth American to be made a corresponding member, Mr. George K. Cherrie being one of the other three upon whom has been bestowed this coveted distinction. The American Museum may well be proud that of the six Americans deemed worthy of inclusion in one or the other of these two groups, three have been selected from its scientific and field staff.

GEOLOGY

Western Trip of Dr. E. O. Hovey.—Dr. Edmund Otis Hovey, curator of geology and invertebrate palæontology, American Museum, has been making a tour of certain points of geologic interest, including Pikes Peak and vicinity, San Francisco, Crater Lake in Oregon, Mt. Rainier National Park in Washington, and Glacier and Emerald Lake (Burgess Pass) in British Columbia and Lake Louise and Banff in Alberta. One of the objects of his trip was to secure photographs and data for the relief models of Pikes Peak, San Francisco, and Crater Lake that are in course of construction in the department of geology.

Summer Work of Dr. C. A. Reeds.—Dr. C. A. Reeds, associate curator of geology and invertebrate palæontology, has been collecting data in New York and in New Jersey to be embodied in an exhibit illustrating "Climates Past and Present."

ANTHROPOLOGY

William Halse Rivers Rivers.—We regret to announce the sudden death of William Halse Rivers Rivers of Cambridge, England, the distinguished English anthropologist. He was a leader not only in this field, but in psychology as well. Like William James, Doctor Rivers passed successively from neurology, through psychology, to anthropology. Then, during the late war, Doctor Rivers took up the problems involved in the treatment and cure of the nervous wrecks brought back from the battle lines. He made a great contribution to medical science by analyzing the type of disorder known as "shell shock" and by developing a method of treatment that resulted in a large percentage of cures. Doctor Rivers was born in 1874. During his life he was the recipient of many degrees from institutions of learning and of a gold medal from the Royal Society. In addition to his researches in psychology and neurology, he studied native life in little-known parts of India and the South Seas. The untimely death of Doctor Rivers has deprived the world of one who was a real leader in several fields of scientific endeavor.

The Angrand Prize for 1923.—The prize of 5000 francs established by Monsieur Angrand will be awarded in 1923 to the best work, whether published in France or elsewhere, during the years 1918–22, on the history, archæology, or languages of the indigenous races of America prior to the arrival of Christopher Columbus. It is requested that contestants send ten copies of their works to the office of the secretary of the Bibliothèque Nationale before January 1, 1923. To works so sent the adjudicators may add others deemed worthy of inclusion. Early in January a list of works admitted to the competition will be sent to those of the adjudicators living outside of Paris, with the request that they designate before February 15. 1923, such additional works as appear to them worthy of being considered. Two copies of each work so designated should be placed at the disposition of the adjudicators.

The prize cannot be divided and a work must have the vote of ten of the eighteen adjudicators before an award can be made.

In 1918 the Angrand prize was bestowed upon Dr. Herbert J. Spinden, at that time assistant curator in the department of anthropology, American Museum, for his *Study of Maya Art.*

FOSSILS

The First Mounted Skeleton of a Dinosaur.—The *Hadrosaurus* skeleton in the museum of the Philadelphia Academy of Sciences was probably the first attempt to restore and mount the entire skeleton of a dinosaur. It was found in 1858, described by Doctor Leidy in 1859, and mounted by Waterhouse Hawkins some years later. The original bones were not used in the mount, but plaster casts were made of them, the missing parts modelled chiefly by analogy with modern reptiles, for very little was then known about dinosaurs. It is on the whole remarkably successful, considering the time when it was made. The skull was modeled from the modern tuatara lizard of New Zealand, as no dinosaur skulls were then known. This was a guess very wide of the mark, but the great variety of proportion and ornament in the skulls of various duckbill dinosaurs makes it still very doubtful what the skull of *Hadrosaurus* was like, as none have been found. It was thought at one time that *Hadrosaurus* was identical with the great western duckbill dinosaur *Trachodon*, but present evidence makes this improbable, although it was nearly related.

So far as the skeleton is concerned, the general proportions are quite correct, and the pose is not at all bad. The breastbone and the lower part of the pelvis are entirely wrong. But when one compares this mount with the restorations (models) of two European dinosaurs, *Megalosaurus* and *Iguanodon*, made by Waterhouse Hawkins in 1853 and still to be seen in the Crystal Palace at Sydenham, London, it shows a vast stride forward towards understanding the true form and proportions of dinosaurs. The short, squatty, toadlike proportions given to the Crystal Palace models are altogether unlike these dinosaurs, as we now know them to have been.

The discovery of the Age of Reptiles, like the discovery of America four centuries ago, was not all accomplished at one stroke. Rather it has been the result of a succession of explorations and researches into the records of the rocks. Step by step we have come to realize what dinosaurs were really like, their extraordinary proportions and immense variety of size and form and habits, and how large a part they played in the past history of the earth. The discovery of the *Hadrosaurus* may be considered as one of the great pioneer advances in revealing this world of ancient life.

The *Hadrosaurus* skeleton, representing what was probably the first attempt to restore and mount the entire skeleton of a dinosaur

GATHERINGS OF SCIENTIFIC SOCIETIES

American Association for the Advancement of Science.—The summer session of the American Association for the Advancement of Science was held under the auspices of the Pacific Division of the Association from June 22 to June 24 at Salt Lake City. A research conference, at which Dr. John A. Widtsoe presented the topic, "Research Problems of the Great Basin," figured in the exercises of the first day. At the evening session the retiring president of the Pacific Division, Dr. Barton Warren Evermann, gave an address on "The Conservation and Proper Utilization of our Natural Resources." On June 23 a symposium of addresses was delivered on "The Problems of the Colorado River," followed in the evening by a banquet, at which Prof. James Harvey Robinson spoke on "The Humanizing of Knowledge." The concluding day was devoted to excursions and entertainments.

Palæontologische Gesellschaft.—A meeting of the Palæontologische Gesellschaft was held at Tübingen, Württemberg, August 9–12. An attractive program was provided, including, in addition to addresses and papers, visits to the collections in the Geologic-Palæontologic Institute and to sites of geologic interest. The gathering was under the presidency of Professor Othenio Abel, of the University of Vienna, to whom was recently awarded the Daniel Giraud Elliot Medal. This medal is bestowed annually upon the author of such paper, essay, or other work on some branch of zoölogy or palæontology published during the year, as is in the opinion of the judges most meritorious and worthy of honor. It was Professor Abel's *Methoden der Paleobiologischen Forschung* (which President Henry Fairfield Osborn in presenting the medal referred to as an "inspiring work") that was deemed worthy of this coveted distinction. The medal, which carries with it an honorarium, has been previously awarded to Dr. F. M. Chapman, Mr. William Beebe, and Mr. Robert Ridgway.

FREE EMPLOYMENT BUREAU FOR ENGINEERS

The four national engineering societies, the offices of which are at 29 West 39 Street, New York City, maintain a free employment bureau that is in a position to furnish engineers, executives, and draftsmen to those requiring the services of qualified men in the different branches of engineering. The administration of the bureau is in charge of Mr. W. V. Brown, to whom applications should be addressed.

OTHER INSTITUTIONS

The Buffalo Society of Natural Sciences.—Important services have been rendered to the community by the Buffalo Society of Natural Sciences as indicated in the annual report of its president, which is printed in the July issue of *Hobbies*, the organ of the society. New exhibits have been installed in both the Old Museum and the New Museum. It is conservatively estimated that as many as 36,000 individuals visited the former building and no less than 39,000, the latter—a total of 75,000, during the twelve months. The work done among the school children deserves especial emphasis. During the year 284 lectures were delivered by Professor Pease to a total of 26,517 boys and girls. These lectures were closely correlated with exhibits in the museums and many of them were followed by arranged visits to the museums. A "children's story hour" on Saturday mornings, the "museum games," and the Roosevelt Field Club, which in the winter conducted a course of Sunday afternoon lectures on "How to Become a Young Naturalist" and in the spring and fall took its 270 members on hikes into the country, are other evidences of what the Buffalo Society of Natural Sciences is doing to stimulate the interest of the young in the world of nature. The society has a collection of upward of 35,000 lantern slides, arranged in more than 700 lecture sets, and these have been loaned widely for use in the home, before organizations, and in churches and schools. Last summer the society operated its first summer camp in the Allegany State Park, and although a guarantee fund was established to protect the society against loss, the camp was run so economically that it was possible to return to the guarantors the sum pledged.

News from Kartabo.—In the work of the Tropical Research Station of the New York Zoölogical Society an incubator is proving of rare value, for by means of it Mr. William Beebe, the director of the Station, and his associates are able to study the anatomy and the habits of rare young birds. In a recent letter Mr. Beebe writes: "I have tried for years to get very young tinamou, and now by putting eggs in, I have a number of young birds, showing most interesting ostrich reactions and instincts. Having never seen nor heard one of their own kind, their behavior is a mental pure culture which can hardly be misinterpreted. Yesterday I found claws on both the pollex and index fingers of the young tinamou as is the case in ostriches, rheas, and hoactzins."

The Museum of the Carnegie Institute.—The Carnegie Institute of Pittsburgh has issued a booklet containing the addresses delivered on its twenty-sixth annual celebration of Founder's Day, as well as tabular matter and other data bearing upon the Institute. Mr. Augustus K. Oliver, secretary of the Board of Trustees, in reporting upon the progress of the year, referred to the fact that the collections of the museum had grown greatly, both through explorations in distant fields and through the donations of friends. Advanced studies under the auspices of the curators of the museum are being pursued by numerous students of the University of Pittsburgh, and many hundreds of pupils from the schools have benefited as a result of conducted visits to the museum.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Patrons: Dr. Ernest G. Stillman and Mr. Edward C. Moore, Jr.

Fellow: Mr. Graham Sumner.

Life Members. Messrs. Thomas Andrew Feuss and D. E. Pomeroy.

Sustaining Member: Henry F. Herpers

Annual Members: Mrs. Charles H. Ferry; the Misses Florence V. Ball, Mary E. Reed; Sir George May; The Honorable W. E. Horne, M. P.; Dr. Adolph Reich; Messrs. G. A. Caballero, Arthur A. Chalmers, George H. Clark, Vernon Munroe, and Frederick J. Ziegler.

Associate Members: Mesdames Helen Chapman, William M. Levey, Frances E. Monson, Hannah Wallden, C. S. Williams, Charles Albert Woodruff; Dr. George Sanford Foster; Messrs. Fred G. Anders, J. Edward Carlson, T. B. Kurata, Russell C. Leibenguth, Joseph W. Lewandowski, Francis B. Ray, Karl P. Schmidt, G. G. Scranton, M. Vonsen, and Eastern Liggett School.

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THE JOURNAL OF THE AMERICAN MUSEUM

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

SEPTEMBER–OCTOBER, 1922

[Published October, 1922]

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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A MONARCH OF THE PLAINS DEPOSED BY CIVILIZATION

One of the last of his race, this old bison bull might almost seem to be mourning the sad history of the bison in its final chapter. Photograph reproduced through the courtesy of Mr. Le Roy Jeffers, Secretary of the Associated Mountaineering Clubs of North America

NATURAL HISTORY

VOLUME XXII SEPTEMBER-OCTOBER, 1922 NUMBER 5

CAN WE SAVE THE MAMMALS?

BY

HENRY FAIRFIELD OSBORN AND HAROLD ELMER ANTHONY

The American Museum of Natural History is working hand in hand with the New York Zoölogical Society, with the Boone and Crockett Club, with the American Game Protective Association, with the American Bison Society, and the National Association of Audubon Societies, with the United States Biological Survey of Washington, with the National Parks Service of the United States Department of the Interior, with the American Society of Mammalogists, and with officers of the British, of the Indian, of the Australian, and of the British Colonial and Insular governments, to retard the inevitable CLOSE OF THE AGE OF MAMMALS. This title, chosen for a forthcoming statistical article[1] by the present authors, is not the cry of the alarmist; it is the expression of an actual and most melancholy fact, namely, that the glorious AGE OF MAMMALS is closing, that man will soon be alone amid the wreck of creation; that many of the races of man himself are passing under the inexorable law of extinction. The title of the present article, "CAN WE SAVE THE MAMMALS?," is designed to strike a note of hope as to what yet may be accomplished toward salvaging for the future the little that remains of the wreck of the past.

FORTY years ago the birds of the world were in great danger of extinction, partly because of the ruthlessness of the man with the gun whom we will not designate a sportsman; partly because of the frivolous demands of the equally ruthless woman of fashion. As a glorious reward to the friends of the Audubon Societies in America and of the Plumage Bill Group and similar societies in Great Britain, the birds have been saved in English-speaking countries. Irresponsible destruction of game birds has been checked all over the North American continent and birds of all kinds are now multiplying. The destruction of birds of beauty and of song for the relentless purposes of fashion has been stopped so far as North America is concerned, and has recently been arrested all over the British Empire; it remains to check and stop it in the Latin countries. Not yet can it be said, however, that the birds of the world have been saved, because destruction of the superb pheasant family (Phasianidæ) of Eastern Asia and of the still more brilliant birds of paradise (Paradiseidæ) of New Guinea and adjacent islands is still proceeding with alarming rapidity.

The saving of the birds renders us hopeful that certain of the finest kinds of mammals, including those which are nearing extinction from natural causes, as well as many of the fur bearers that have been reduced in numbers through persistent persecution, can still be saved by three great movements along lines similar to those which have resulted in the preservation of the birds and of certain forests.

First, we may point out the alarming rate at which the mammals are now being slaughtered for commercial purposes and demonstrate that such devastating measures are ill-advised in that they are defeating their own ends. By pointing out the inevitable consequences of the rapid destruction of trees, conservationists were able to save some of the historic forests of Europe and of America. Those championing the right of survival of our game animals may in like manner refer to the fact that the unchecked destruction of any natural species, whether it be a *tree*, a *bird*, or a *mammal*, may mean an immediate monetary gain to a few individuals, but must mean ultimate monetary loss, not to mention *moral* and *spiritual* loss, to the entire community, while posterity is thereby robbed for all time of what should rightly be part of its heritage.

The *second* measure in this great

[1] *Journal of Mammalogy*, November, 1922

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THE PRONGHORN ANTELOPE

This animal faces extermination today and with its disappearance will go one of our most typical North American mammals conservation movement is again similar in character, whether it concerns trees, birds, or mammals: it is designed to prove that the final destruction of a species is against the general welfare, that it is unnecessary because stimulated by entirely *artificial* and not by real human needs. We cannot deny fur clothing to the Eskimo, a fur coat to the northern woodsman, the reasonable use of furs in civilized communities for dress and for ornament, any more than we can deny the reasonable use of trees for economic purposes, or of birds as a natural source of food supply. It is not the reasonable use of mammals which is bringing the great Age of Mammals to a close; it is the unnatural uses created by entirely artificial means, such as the wearing of furs purely as a means of display of wealth and for the purpose of gaining social position or standing.

Our *third*, and what may ultimately prove to be our most effective, measure in trying to save the mammals is that which has been applied to such advantage in the case of the birds, namely, creation among our school children of the sentiment of conservation, of the love of nature, of the appreciation of the wonder and beauty of mammalian life, of the realization of the great efforts which nature has put forth to produce the mammal kingdom, and of the enormous periods of time that have been required for its evolution; the sentiment, moreover, that mammals are the friends of man, that they are prototypes of our strength as well as our weakness, that they are among our best companions, that even some of the wildest of animals will become tame and companionable as soon as the gun of the market hunter and that of the sportsman are silenced.

These three watchwords of the mammal conservation movement are like the little flags known as guidons which direct lines of cavalry both in army maneuvers and in battle. Conservation is, in fact, partly a matter of skillful maneuvering following a long period of preliminary public education; it is also partly a matter of downright warfare. Some veterans, like the dean of American conservationists, Dr. W. T. Hornaday, always sound the battle cry; others, like the late lamented C. Gordon Hewitt, leader of the conservation forces in Canada, try to advance by the gentler methods of conciliation and of education. To save the mammals it is certainly necessary to marshal all our forces, both militant and persuasive, and to use all or any of these methods.

To enlist the coöperation of the readers of Natural History, let us present as our first line of attack some of the actual facts of the present period of slaughter which lead us to believe that unless there is a drastic change of action the Age of Mammals is surely coming to a close.

ELIMINATION OF THE FUR AND HIDE-BEARING ANIMALS AT THE RATE OF THIRTY MILLION A YEAR*

Nothing in the history of creation has paralleled the ravages of the fur and hide trade, which, with the bone fertilizer trade, now threatens the entire vertebrate kingdom. Furs are no longer worn primarily for protection in cold weather. Furs are now a fashion, just as feathers were forty years ago. The trade has passed almost entirely into the hands of people of Oriental and Asiatic origin. Millions of dollars are spent annually in advertising. Furs are worn in midsummer purely for personal adornment, or to make a display of wealth and luxury.

Some realization of the destruction now going on among the mammals is afforded by a glance at the statistics of our fur trade. After consulting a great number of fur-trade journals and reports, Mr. Anthony has compiled figures for the years 1919, 1920, and 1921, showing the large number of skins sold all over the United States at the fur auctions. The

*This section of the present article is taken, with slight modification, from the article by the same authors that will appear in the *Journal of Mammalogy*, November, 1922.

best of these journals is the *Fur Trade Review*, a large monthly publication given over to everything of interest to the fur dealer. In the *Fur Trade Review* one can find a list of all offerings at the different fur auctions, and it may be assumed that these figures are sufficiently authentic to be used in this article. In interpreting data of this nature, there are several features to be kept in mind. It is possible that the records of skins sold during any one year will not be a true record of the actual killing for the period in question, inasmuch as, during a time of high prices, skins may be brought out of storage to be marketed under favorable conditions. A large number of skins sold during a certain year may, therefore, have been collected over a period of several years. However, as we have had a few "boom" years, it is quite likely that all of such stored skins were brought out sometime ago and disposed of, so that the more recent figures probably indicate animals killed within a year of their sale. Furthermore, lots of skins may be sold at a spring auction and shipped to another part of the country to be resold in the fall, thus giving a duplication of numbers. However, omission of the winter sales of 1921 from this list more than offsets any duplication that may have occurred.

The discounted total of all skins sold for the three years in question reaches the alarmingly large figure of 107,689,927 skins. Moreover, this figure indicates only the slaughter of the animals which reached the market as skins. To show properly the actual slaughter that is taking place, one must allow for animals that were killed but not sent to the market because their skins were unprime, also for a considerable percentage

Photograph by H. E. Anthony

Anyone who loves mammals will find in the raccoon a most fascinating pet, a little mischievous at times but possessed of disarming friendliness. Unfortunately most people know this animal best as a popular fur and so miss all of the bright, lively fun that tingles in the tips of his almost human fingers of wounded animals which, although they escaped the hunter, were killed nevertheless, through his agency. A glance at some of the more noteworthy species sought by the fur trade that are indicated in the following table will show something of the scope and demands of this industry. Altogether the fur trade utilizes, at the very least, about one hundred twenty-five species, the exact number being difficult to determine because of the employment of trade names, which mean nothing to the zoölogist. Mr. Anthony has included in the table only thirty-two of the more important species out of the one hundred twenty-five species which are being destroyed.

THE RODENTS AND INSECTIVORES OF AMERICA AND EUROPE

A glance at the figures showing the number of skins of beaver (*Castor canadensis*) sold demonstrates what proper protection of a fur-bearing species may accomplish. Formerly trapped all over

POPULAR NAMES OF THE ORIGINAL FUR BEARERS WHICH HAVE BEEN SOLD DURING THE PAST CENTURY	SCIENTIFIC NAMES OF THE SAME FUR BEARERS	TOTAL NUMBERS BOUGHT OR SOLD BY THE FUR TRADE DURING THE YEARS 1919, 1920, 1921
Beaver	*Castor canadensis*	420,490
Chinchilla	*Chinchilla lanigera*	36,448
Mink	*Putorius vison*	2,540,971
Fisher	*Martes pennanti*	32,014
Marten	*Mustela americana*	309,808
Ermine	*Putorius arcticus*	3,492,412
Sable	*Mustela zibellina*	57,908
Fur Seal	*Callorhinus alascanus*	85,164
Red Fox	*Vulpes fulvus*	1,295,258
Cross Fox	" "	32,296
Silver Fox	" "	26,350
Land Otter	*Lutra canadensis*	111,059
Sea Otter	*Latax lutris*	76
	Total	8,440,254

FUR BEARERS RECENTLY INTRODUCED BY THE FUR TRADE TO REPLACE THE DIMINISHING ORIGINAL FUR BEARERS

POPULAR NAMES	POPULAR TRADE NAMES	SCIENTIFIC NAMES	TOTAL DURING 1919-21
Muskrat	Hudson Seal	*Fiber zibethicus*	14,109,288
Nutria	Nutria	*Myocastor coypu*	1,941,784
Squirrel	Squirrel	*Sciurus vulgaris*	14,858,316
Marmot	When dyed, as Mink or Sable	*Marmota sp.*	3,107,759
White Hare	French Sable or Electric Seal	*Lepus sp.*	3,713,036
Mole	Mole	*Talpa sp.*	23,801,905
Stone Marten	Stone Marten	*Mustela foina*	107,075
Red Sable	Kolinsky	*Mustela sibirica*	1,151,553
Skunk	Skunk	*Mephitis sp.*	6,895,674
European Polecat	Fitch or Sable	*Mustela putorius*	1,094,411
Wolf	Wolf	*Canis sp.*	1,094,502
White Fox	White Fox	*Alopex lagopus*	166,071
Bobcat	Lynx	*Lynx rufus*	191,799
Raccoon	Raccoon or, dyed, as Lynx	*Procyon sp.*	1,713,700
American Opossum	Opossum	*Didelphys virginiana*	9,787,742
Australian Opossum	"	*Phalanger sp.*	4,265,621
Ring-tailed Opossum	"	*Pseudochirus and Phalanger sp.*	1,321,625
Koala[1]	Wombat	*Phascolarctus cinereus*	208,677
Wallaby	Kangaroo	*Macropus sp.*	1,722,588
		Total	91,253,126

[1]Technically the Koala and the Wombat are different, but the Koala is classed as "Wombat" in fur circles.

the American continent, beaver were brought almost to the verge of extermination, but for many years they have been protected and allowed to increase unmolested. As a result, during the period of the past three years, about 420,000 skins have come to the market.

The table indicates how relentless has been the pursuit of the muskrat (*Fiber zibethicus*), an animal which at one time brought such a low price at the sales that it was scarcely worth while to trap it; when muskrat fur came into fashion under the trade name of "Hudson seal," and the public demanded it, a systematic campaign of trapping began, which brought muskrat skins to the market by the millions and now seriously threatens the very existence of this species. Squirrel (*Sciurus*) skins, most of which, we believe, have come from the Old World, make up a huge total of more than 14,000,000, and this is another example of a skin, formerly valued very slightly, that has come into prominence because of the demands of fashion. Skins of the insectivorous moles (*Talpa*) reach even a larger aggregate. The skin of the mole is so small that only since the passion for furs has become extreme has there been any incentive for men to molest this animal. Most of the skins disposed of at the sales tabulated on p. 393 must have come from the Old World, and the mole, as anyone knows who has tried to trap it, is an exceedingly difficult animal to capture. More than 23,000,000 of these little animals were sacrificed to the insatiable demands of the fur trade. The mole, it may be claimed, is a small, insignificant species, and here and there among the list of fur bearers are other animals for which no economic value may be urged, but the presentation of this subject is intended to show the great destruction of mammal life, irrespective of species, and the possible desirability of exterminating any particular animal does not enter into the discussion.

THE SMALL CARNIVORES OF THE FOREST

The mink (*Putorius vison*), which was one of the first fur-bearers to be trapped in this country and which has remained a favorite for the past century, is an animal that apparently nowhere survives in very great numbers. However, since its skin has brought such a good price at auctions, our country has been combed over for mink, and the annual average yield of the last three years has risen to more than 500,000 skins. This is a very serious, if not fatal, tax upon the ability of the animal to maintain itself. The winter fur of the ermine (*Putorius arcticus*) has been worn from time immemorial and has been the fur of royalty. Today its use is much more general, witness the fact that no less than 4,400,000 skins of these little animals have come to the market during the three-year period. Before the recent craze for furs had begun, the skunk (*Mephitis*) enjoyed the immunity which nature intended him to have, and his skin brought such a low figure at the auctions that it scarcely paid anyone to run the risk of removing it. Now skunk fur commands such a high price that the trappers have covered all the American forests and plains area and more than 6,000,000 skins of this animal were disposed of at the auctions held from 1919 to 1921.

The raccoon (*Procyon*) is another animal the fur of which had but little value in early years; but to show how its status has changed, it will be necessary only to point out the total sales for the three-year period, amounting to 1,700,000 skins. One of the furs most widely sold today was formerly worth but a few cents,—we refer to the American or Virginia opossum (*Didelphys virginiana*). In those days there were few individuals other than boys who would give their time to skinning it, but since it has come into fashion, a vast number of market hunters have been occupied in obtaining the more

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A GOOD OLD-FASHIONED FAMILY

The prolific opossum can withstand the aggressions of enemies far better than most other mammals and doubtless will be one of the few survivors when the mammals stand in the last ditch against the forces of modern civilization

than 9,700,000 skins subsequently placed on sale.

The average man has been led to suppose that wolves of the forests and plains have become almost extinct over most of the country. In the figures given for the wolf (*Canis lupus*), there are lumped together a great many species of coyotes and wolves, but, even so, the very large total of more than

1,000,000 skins is very significant of the great campaign that is being carried on against this animal, and at this rate it will not be very long before the wolf is extinct indeed. The red fox (*Vulpes fulvus*) has been such a prime favorite that great numbers of skins of this animal have come to the fur sales, and we understand that in some regions of the north the fox is virtually on the brink of extermination. More than 1,200,000 skins taken during the three-year period evidence a rate of destruction far greater than that which an animal like the fox can survive. On the other hand, the rarer foxes, the silver and the black, have been protected and reared in captivity, and we have learned upon good authority that most of the skins sold are those of ranch-reared animals. The fact that it was possible during the three-year period to place on the market the skins of more than 26,000 ranch-reared foxes furnishes a clew as to the proper methods for supplying the fur market.

Photographed by Roy Chapman Andrews

Alaskan fur seal in a rookery protected by the United States Government

CARNIVORA OF THE SEA

The sea otter (*Latax lutris*), which furnishes the most beautiful of all furs, was represented on the fur counters by only seventy-six pelts—a sad commentary on the disappearance of this animal. Inasmuch as the sea otter is protected over most of its known range, some of the skins were doubtless taken illegally and unless some radical change for the better takes place, it will no longer be obtainable by the fur dealers. When the killing of the Alaskan fur seal (*Callorhinus alascanus*) had reached such serious proportions that the government found it necessary to intervene, and treaties were entered into establishing the right of this country to protect this animal, the northern herds were placed under supervision and the annual killing controlled by law. This regulation has worked out most satisfactorily, and a glance at the figures shows that over the three-year period more than 85,000 skins were sold—a very satisfactory total when one considers the high price commanded by the individual skin.

DEVASTATION OF FUR BEARERS IN AUSTRALIA

The Australian marsupials have known to their cost the increased demand for opossum, and the drain upon the wild life of Australia is shown by the marketing of a total of more than 4,000,000 skins of the so-called "Australian opossum,"—several species of small marsupials (*Phalanger*) going under this name—a total of more than 1,300,000 skins of the ring-tailed opossum (*Phalanger* and *Pseudochirus*), and more than 208,000 skins of the koala (*Phascolarctus cinereus*), or marsupial bear. As to the inroads by pelt hunters ". . . the Queensland Minister for Agriculture has said that in 1919–1920 no fewer than five and a quarter million 'possums and a million native bears were slaughtered in Queensland."

The Australian naturalists have been desirous of conserving their wild life and have shown this in their restriction of the number of native mammals which they have allowed scientific expeditions to take out, but, on the other hand, their trappers and traders have shipped out through the principal ports literally ton upon ton of baled skins, and whole regions have been stripped of mammal life, so that Mr. W. H. Dudley LeSouef, of the Sydney Zoölogical Park, says that some of the species have been brought down so close to the danger point that a year of drought will exterminate them completely over large areas.

Curator Gregory[1], who has recently returned from a tour of observation in Australia, writes: "The principal causes for the rapid extinction of marsupial mammals in Australia, as far as I could learn while there, are as follows: (1) The process of clearing the land over thousands of miles, by ringing, chopping and burning the trees, not only destroys the arboreal marsupials but practically sterilizes the burned district. The progress in clearing the land is extremely rapid, as may be seen in riding over thousands of miles in Queensland, Victoria, New South Wales, and South Australia. (2) The introduced rabbits, which in some districts are present in enormous numbers, naturally tend to crowd out the native fauna. (3) Foxes, introduced first to kill off the rabbits, take a heavy toll of the marsupials. The poison used to kill the foxes does more damage. (4) My companion, Mr. Raven, found that the dingoes (*Canis dingo*) had nearly cleaned out the ground-living marsupials in the deep mountain ravines of the Guy Fawkes region in northern New South Wales. (5) The koala (*Phascolarctus*) has been the subject of a devastating plague, which made them extremely rare in Queensland, in localities where they were formerly very abundant. In spite of all this, my impression is that the marsupial fauna of Australia as a whole is far from being exterminated, especially in the less settled districts of the great continent. The proposed establishment of great state parks and sanctuaries, even if it does not fully protect the animals from fur hunters, will give them a protection from the deadly fires and from the destruction of their natural environment."

AN INDUSTRY DESTINED TO BE SHORT LIVED

The figures just cited give a little insight into what the fur trade is doing toward bringing about the close of the AGE OF MAMMALS. In a few years some of the mammals now sought by the trappers will be killed off to a point where they will not repay trapping, the numbers taken being insufficient to justify the expenditure of time and effort. Meanwhile, America has become the center of the fur trade. Before the war London was the world's fur market, but it now appears that the control has

[1]Gregory, W. K., "Australian Mammals and Why They Should Be Protected." *Australian Museum Magazine*, Vol. 1, No. 3, p. 65. December, 1921.

passed to the United States, and the great market of the present day is here.

The figures given out by the Fur Dressers and the Fur Dyers Association show that in New York City alone more than 80,000,000 skins were dressed and more than 97,000,000 were dyed by the members of this association during 1918, 1919, and 1920. Thus it would appear that the life of this industry throbs in our own country, and if any proscription is to be written, such as may serve to prolong the trade itself, the initiative should be taken by America. The more intelligent fur dealers realize that the wild animals are an asset to their industry, and judging by the editorials of the different journals, and the articles that appear, we believe that the majority of such fur dealers, if the matter were put to a vote, would encourage more humane methods of trapping and a more extended control over the wild animal supply. It would suit their own purposes better if animals could be taken only during that part of the winter when the furs are in their prime; the restriction of the hunting period to such a time of the year would be an important step toward the conservation of fur bearers. But as matters now stand, when fur prices begin to mount to such figures that a few skins represent many dollars, then in the out-of-way places where laws have but little significance at any season of the year, men go out and kill every fur bearer that they come upon, and run out their traps for whatever they may catch. Therefore, we believe that if some more intelligent and humane methods of checking this appalling slaughter are not soon inaugurated, the fur craze will have been the means not only of closing the AGE OF MAMMALS but of terminating a great industry.

RAPID EXTERMINATION OF THE GREAT MAMMALS OF AFRICA[1]

As regards organized destruction of animals to supply pelts for the fur trade, Africa is unimportant, for it is the only continent where relatively few mammals have hides heavy enough to be classed as "fur." This is not surprising considering that the entire country is tropical or subtropical and the higher mountains are insular in character and furnish no properly situated, cold environment suitable for the development of "fur" animals. Excluding a few showy monkeys, hyraxes, and duikers, the African mammals whose hides appear more regularly in trade channels are nearly all carnivores, mostly nocturnal in habit. So far as individual value is concerned, lions and leopards are by far the most important. Foxes, jackals, aard-wolves, genets, servals, lynxes, and other cats, civets, mongooses, zorillas, and otters are types whose skins are found less frequently in the trade. Squirrels and flying squirrels, which in Europe and Asia are so important a contingent, in Africa neither have soft enough fur nor occur in sufficient numbers to invite exploitation in this respect.

While the lion has been wiped out in all the regions north of the Sahara and south of the Orange River, it is not because the hide commands the highest price paid for that of any African carnivore. The confinement of the lion within its present restricted domain must be ascribed rather to the activities of hunters, often acting in the interests of steadily advancing civilization. The leopard, or "panther" of the fur trade, has a much wider distribution in Africa than the lion, for, unlike the latter, it inhabits forest regions as well as open country. Due to the natural shelter thus offered and also to the fact that the leopard is more cautious by nature, it has been able to hold its own in spite of the fact that thousands of pelts reach the coastal regions every year. Of course, African natives have little use for skins. Those of lions, leopards, and okapis are occasionally worn by persons of distinction, and the skins of small Felidæ and primates are used to decorate dan-

[1]Prepared by Mr. Herbert Lang of the American Museum of Natural History.

Photographed by Carl E. Akeley

IMPALLA ANTELOPES

These dainty creatures, mirrored in the still water, represent only one of the numerous species of antelopes that have proved so fascinating to the traveler in Africa

DISTRIBUTION OF ELEPHANTS AND MASTODONS

Present

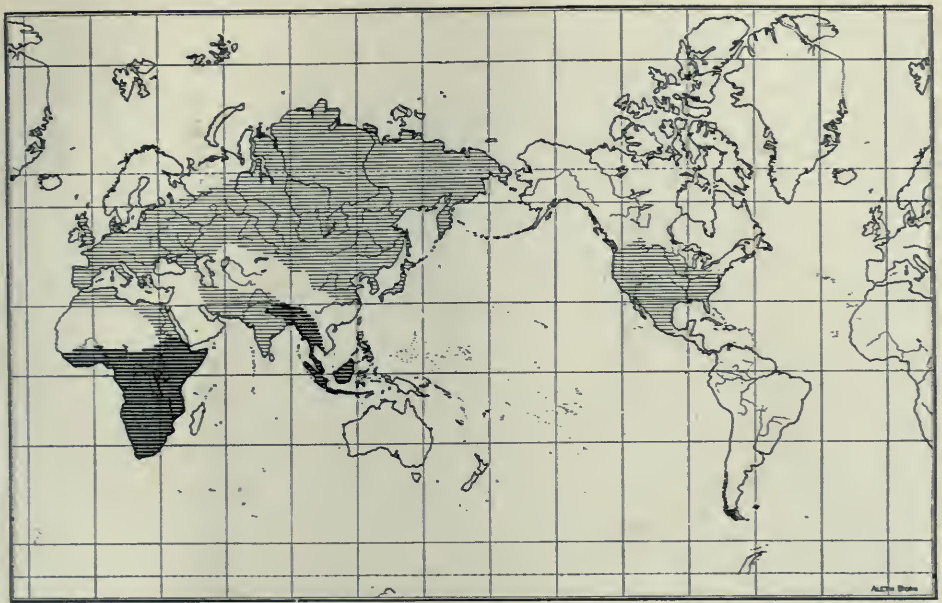
Former

In earlier geological times elephants and mastodons had a very wide range as shown by the above map

cers. In South Africa alone large rugs are made of skins, and a distinctive pattern is secured by combining the pelts of various animals, such as the jackal, genet, civet, and duiker, as well as of antelopes other than the duiker. The Masai and Kikuyu, who live in higher altitudes in East Africa, are very proud of the cloaks they wear, which consist of the skins of tree hyraxes (*Dendrohyrax*) sewed together. But on the whole, native needs in these respects are small and easily controlled. Among the primates the baboons and other forms have furnished a few pelts, but certain Abyssinian and East African *Colobus* or *Guereza* monkeys have suffered most. Their hides of glossy black, silky hair, draped on the sides with long fringes of flowing white, and terminating at the end of the tail in a magnificent white brush are coveted by natives and Europeans. In most parts the government now confiscates these skins, only two of which can be exported by any one party and then only by special permit.

Africa has been a great paradise for game animals for a century past and has naturally suffered heavily from the unavoidable destruction that attends the progress of civilization. The larger members of its fauna have been the principal victims. The numerous vast herds observed by earlier travelers in Africa, especially in the southern and eastern parts, have now dwindled to such an extent that it is doubtful whether even the protection afforded by game preserves will be able to prevent their ultimate disappearance.

Total extinction in relatively recent times has claimed only two of the larger African mammals: the quagga (*Hippotigris quagga*) and the blaubok (*Egocerus leucophœus*), both of South Africa. Undoubtedly the need for the meat, the use of the hide, the desire for sport, and wanton slaughter were the chief factors



Contrast the present restricted range of the rhinoceroses with the territory over which they roamed before the Age of Mammals passed the climax of its development

in the destruction of the quagga, a zebra striped only on head, neck, and shoulders. How suddenly the quagga and the blaubok disappeared is evident from the fact that only a dozen specimens of the former and only five of the latter are preserved in the various museums of the world. In the Aberdeen district the last quaggas were killed in 1858 but in Orange Free State a few held on till 1878; notwithstanding many rumors to the contrary, none are known to be alive now. The blaubok appears to have been scarce always, at least as far back as records go; by 1731 it seems to have been confined to the Swellendam district, in the southwestern portion of the Cape Colony, and the year 1800 probably marks its complete extinction. A close relative of the quagga, the mountain zebra (*Hippotigris zebra*), is even now on the verge of dying out. According to Haagner, one of the well-known sponsors of the movement for game protection in South Africa, the mountain zebra is now represented only by small herds aggregating about 400 head in all and restricted to the mountainous regions about Cradock, Oudtshoorn, and George.

The handsome bontebuck (*Alcephalus pygargus*), formerly widely distributed, now lingers only near Bredasdorp and Swellendam, profiting by organized protection. The blesbok (*Alcephalus albifrons*) has a more enviable record; its facility in adapting itself to a semi-domesticated mode of life has made its future more assured, for many farmers in South Africa maintain a few herds. Not to speak of really rare creatures like the forest-living okapi (*Okapia johnstoni*), which seems on the verge of natural disappearance, other game, once plentiful, is becoming alarmingly scarce. The black wildebeest (*Connochætes gnu*), the greater koodoo (*Strepsiceros strepsiceros*), and in many regions buffaloes and elands have been greatly reduced. Their local extinction in the past has been due to the periodical occurrence of rinderpest, a disease which practically annihilated them in extensive areas. Present conditions of inadequate protection do not allow recovery through the gradual formation of new herds as in times when these animals were unmolested by sportsmen and settlers.

Furthermore native chiefs have always vied with one another to come into possession of a horn staff of unsurpassed length. Giraffes also have been subject to ruthless destruction in Nubia and especially in South Africa, and the elephant, due to the value of ivory, is now extinct in many quarters and found in numbers only on the eastern and northeastern borders of the great equatorial rain forest.

Of the white rhinoceros (*Ceratotherium simum simum*), once believed to be entirely extinct in South Africa, a few still enjoy a refuge in Zululand; and thriving colonies of a closely related form have been discovered in northeastern Belgian Congo and in parts of the Sudan east of the Nile. What contributed more than anything else to the gradual destruction of this animal was the market value of the horns. Superstitious peoples of far-off Asia would pay almost any price for powder made from the horns, for it is supposed to be a magic medicine.[1]

Photographed by Kermit Roosevelt

The white rhinoceros, for all its size, strength, and ugliness, is no match for the forces of destruction which are leagued against it. Picture reproduced by permission of Charles Scribner's Sons, from *African Game Trails* by Theodore Roosevelt, copyright 1909, 1910

VANISHING WILD LIFE OF SOUTHERN ASIA

Colonel F. C. Faunthorpe, Commissioner of Lucknow, India, and well known for his deep interest in the preservation of game in India, writes (July 16, 1922):

"If you wish to obtain a representative collection of the wild animals of the plains of India, which, set up in groups with reproductions of their natural surroundings, will form a collection of great beauty, and one which at present does not exist anywhere in the world, I would urge that there is no time to lose. Owing

[1]This superstition was in earlier centuries prevalent in Europe. The reader is referred to the article by Frederic A. Lucas, entitled "The Unicorn and His Horn," NATURAL HISTORY, November–December, 1920, pp. 532–35.

Photographed by N. W. Frost

Anyone who has seen the wapiti in its native haunts must view with consternation the impending extinction of such a splendid creature

to changed conditions in India, conditions which are likely to persist, game is, in many places, decreasing to the point of extinction, and it is probable that within a short period there will be very little left, except in portions of the Government Reserved Forests (the ultimate fate of which one cannot at present predict), and in the shooting preserves of some of the Indian princes. As an instance, I may say that in the Sitapur District of my Division, in which black and gray partridges were formerly abundant, the district officer recently told me that these birds are practically extinct. In the Hardoi District of my Division, in which the Indian antelope was found in large numbers a few years ago, they are now extremely rare. In the reserved forests of the Kheri District of my Division I beat last Christmas for swamp deer. In what was the best ground for them a few years ago, we did not find a single stag where three or four years ago I should have expected to see at least twenty. . . . It is essential, therefore, that the collection should be made as soon as possible."

To meet this emergency the American Museum has recently completed arrangements with Colonel Faunthorpe and Mr. Arthur Vernay to secure for the new Asiatic hall some of these fine animals of southern Asia before they disappear.[1]

[1]To meet the criticism which may possibly be made, namely, that museums themselves are contributing to the extermination of rare mammals, we would state that the American Museum does not sanction wholesale collecting of disappearing species. It is obvious to all that a natural history museum should be a repository of the actual facts of nature, notably the skins and skeletons of animals, and should some interesting mammal disappear from the face of the earth before such a permanent concrete record of it could be prepared and stored up for posterity, museums would have indeed been derelict in their duty. It can never be stated truthfully, however, by one in possession of the facts, that the American Museum, in any of its activities, is endangering any species of mammal. Only a pair, or a pair with young, is collected when a certain species is struggling hard for existence and on two occasions recently the American Museum has refused offers to collect much needed species of mammals on the grounds that the taking of even a limited number of specimens would depress the balance too heavily.

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Bighorn sheep live in the roughest and most inaccessible regions where the sight of a big old ram is certain to be remembered by the beholder

CLOSE OF THE AGE OF MAMMALS

From the standpoint of the naturalist, the Age of Mammals has long since closed as compared with the close of the Age of Reptiles, which occurred more than three million years ago. Extermination of the large mammals has been going on for a century; extermination of the small mammals has been extremely rapid in the last two decades. In North America alone mammals, broadly speaking, have disappeared within our life time. The present rate of destruction throughout the world from various causes, is probably not less than fifty million a year, of which thirty million represents the demands of the fur trade. The bison is extinct in the United States except for the animals preserved in parks. Through the splendid efforts of the American Bison Society this noble quadruped is now rapidly multiplying. In Canada the wood bison is still holding its own and is, perhaps, slowly increasing. The elk, or wapiti, has disappeared from the greater part of its old range and is now found in its wild condition in only a few of our western states. On the danger line of actual extinction is our beautiful pronghorn antelope, the existence of which is seriously threatened, especially because of the great difficulty in supplying it with its natural conditions of life. Our other two large mammals, the Florida manatee, a wonderful "living fossil," survives in a restricted area and in limited numbers; the splendid elephant seal of the Pacific has been completely killed off except for a small colony in Guadeloupe Island. The sea otter has been very nearly exterminated along the American coasts. The American beaver is extinct over most of its ancient range but has increased in an astonishing manner in the areas where it is protected. Among the great mammals of the sea the California gray whale is nearly extinct. The right whale is in danger of extermination, and the disappearance of the bowhead whale is also threatened. The American Museum has thus far failed in its efforts to secure examples of this splendid species of whale before it disappears.

In many parts of the world, in Australia, in northern and southern Asia, and in North and South America, American Museum explorers are especially charged with the great mission of securing single specimens of these fast-vanishing remnants of the AGE OF MAMMALS before it is too late. Many of the specimens which the Third Asiatic Expedition has secured will be among the last of their kind to find their way to the great museums of the world, because Mr. Roy Chapman Andrews, the leader of the expedition, has observed that their numbers are limited and that they are in near danger of extinction.

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Courtesy of Mr. Herbert Lang

As the elephant walks along beside its keeper, it lowers its pillar-like legs deliberately as though conscious of the crushing force of their descending weight. Although the author has walked around the circus ring for hours with elephants in order to exercise them, he does not recall that one ever came in contact with his foot, and such an experience would indeed be unforgettable. The present picture was taken in the Berlin Zoölogical Park

THE ELEPHANT IN CAPTIVITY

BY

W. HENRY SHEAK

THE elephants are a dying race. In the Pleistocene, and I may say Post-Pleistocene, these giant mammals were the dominant form of animal life. There were many species and, judging from the many fossils found, multitudes of individuals. Charles F. Holder in his thoughtful book, *The Ivory King*, expresses the conviction that the elephant could not have been extinct in Alaska more than five hundred years at the coming of Columbus. The order was clearly divided into two well-defined groups in those early days, mastodons and mammoths, the distinction being based primarily on the structure of the crowns of the molar teeth. These animals had a wide geographical distribution, being spread over all the grand divisions of the earth exclusive of Australia.

Numerous well-defined species have disappeared in recent geological times, leaving only their huge skeletons in the peat bogs and alluvial deposits to remind us of the days when they browsed on the overhanging foliage or thundered through the forest primeval, pursued by savage man with his stone spears and sling shots. A few mammoths only left their entire carcasses, including hide, hair, and stomach contents, frozen in the ice and gravels of Siberia. Of the many forms living so recently, only two, the Indian and the African elephants, survive.

Just how much use Palæolithic man or Neolithic man made of the elephant, we do not know. We find the form of the mammoth drawn and painted on the rock walls of the old caves of Europe, and even carved on a piece of his own tusk. We find his bones among the débris on the floor of these caves, or in the kitchen middens near their mouths, buried with the remains of the reindeer, bison, wolf, cave bear, horse, dog, and man himself. The ivory was carved into objects of use and ornament. It cannot be doubted that primitive man used the flesh of the mammoth for food. It is probable also that he devoted the hide and hair, and possibly the bones, to various purposes. But there is no evidence that early European man ever domesticated the mammoth.

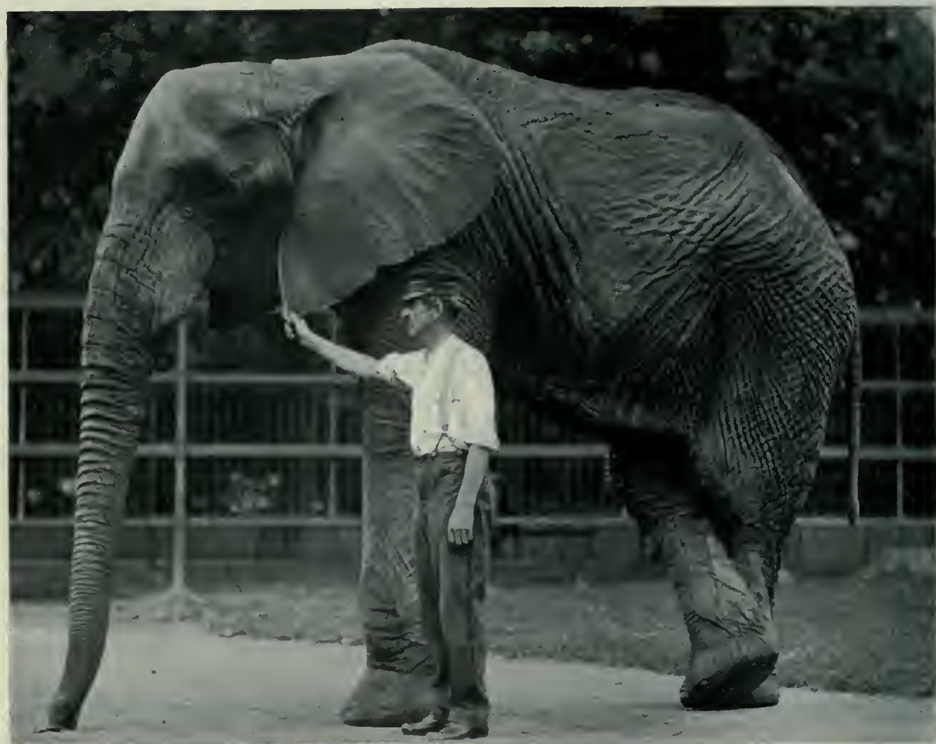
The beginning of domestication of the elephant, like that of other domestic animals, is shrouded in obscurity. When it began, no man knows. But unlike the case of most domesticated animals, the original wild stock of the elephant still persists. Indeed, this great quadruped is not only such a slow breeder, but such an infrequent breeder in captivity, even in its own native climate, that practically all elephants in zoölogical gardens, in traveling menageries, and in domestication even in India, Burma, and Siam, have been obtained from the wild herds of the forest and jungle, and tamed.

Not a few baby elephants, reports say, have been born of adults with traveling menageries in this country. Most of these reports are fabrications. But I know of two well-authenticated births occurring here; in neither case was the mother pregnant when imported. The first of these was in Philadelphia, at the winter quarters of the old Bailey, Scott, and Hutchinson show, in 1880. P. T. Barnum came to Philadelphia to see the baby and offered the owners a goodly sum for this feature attraction, but they only laughed at him. However, Mr. Barnum was not a man to be turned from his purpose and he proposed that the two shows be united. This suggestion proved acceptable and was the beginning of the Barnum and Bailey circus. The baby was named Columbia and lived for many years in the circus menagerie. Although her mother, Hebe, commonly known about the show as Babe, was one of the best-natured elephants I ever knew, the daughter grew meaner and meaner as she got older, until in 1905 or 1906 she had to be killed. Mr. Bates, who was assistant superintendent of elephants for a long period of years, told me she inherited her vicious disposition from her sire. The other baby was born at the Barnum and Bailey winter quarters at Bridgeport, Connecticut, in 1882. He was named Bridgeport and was burned up in the fire in 1887 that destroyed much of the splendid menagerie of Barnum and Bailey.

It is doubtful whether any elephant other than the Indian has been domesticated. The elephants that Hannibal brought against Rome may have been the African. Unfortunately no drawing or other picture has been found to throw light on the subject. From what we know of the African elephant of today, however, it seems extremely doubtful if this species could be sufficiently subjugated to be of any use in warfare. And if Pyrrhus, King of Epirus, could bring Indian elephants to Greece, why could not Hannibal bring them to Carthage?

Twenty years ago the old Forepaugh-Sells show carried two African elephants, a male and a female. They were both of low intelligence and vicious disposition. Frequently the keepers had to hitch an Indian elephant to one of the African elephants to pull it on or off the train. They always had to be kept heavily chained. In our herd of thirty elephants, when I was with the Ringling menagerie in 1906, was one female African elephant. She was not vicious but a veritable "dumb-head."

I think the tallest elephant I have ever seen alive is the big African now in the New York Zoological Park. He is 9 feet, $3\frac{1}{4}$ inches tall, and is estimated to weigh 6000 pounds. He is vicious and cannot be handled. He has worn off his tusks back beyond the lips by fighting the bars of his enclosure. One needs only to look at the rounded forehead and much smaller brain case of the African elephant to expect less intelligence from him than from his Asiatic cousin.



Photographed by Elwin R. Sanborn, New York Zoological Society

The large African elephant at the New York Zoological Park.—This animal is more than 9 feet in height. The aggregate weight of from thirty-five to forty men of average build would be required to offset the total of 6000 pounds which, it is estimated, this elephant would register if placed on the scales

There are few if any animals of such strength and intelligence as the Indian elephant that can be subjugated and tamed to the same degree and in so short a time as this great proboscidian. Practically every elephant in captivity was at first a wild animal, born of wild parents, and reared in the forest. When he is first captured, he is a demon incarnate. But the elephant is a philosopher and when he learns it is useless to fight against his fate, he gives up the contest and straightway decides to make the best of the situation. Most elephants are broken and are safe to handle inside of six weeks.

The brain of the Indian elephant is two and one half times the size of that of man. It is also richly convoluted. In captivity this elephant manifests remarkable intelligence. The dog has acquired much of his sagacity from his long association with man. The elephant has not had the advantage of countless generations of development in human society. Yet what other animal could learn in a few days his place in a big tent and be depended upon to go there and stay there, when told to do so, as is commonly the case with circus elephants? I have known one to stand by his own particular stake for a considerable time without being chained fast.

I once had an experience at Ashland, Kentucky, with the old John Robinson circus, which made me wonder if it is not rather because an elephant does not wish to leave his place than because he is not clever enough to free himself, that we find him standing patiently in one spot fastened only by a chain thrown around a stake. I came into the menagerie a short time after the parade and found Tillie, the largest member of the herd, at a considerable distance from her place, quietly feeding on the rich, succulent grass with which the lot was covered. She very readily went back with me and I took a half-hitch about the stake. In less than five minutes I saw she was loose again. Thinking I had not fastened her securely, I brought her back and this time took extra care in chaining her. I then went out to lunch. When I returned, she was once more grazing. As I was bringing her back for the third time, the superintendent of the menagerie came in and said: "You might as well let her go; she wants to eat grass and will not do any harm. When the people are in, she'll stay in her place." I then watched her. She took hold of her chain, but did not pull a steady pull, instead shaking and wriggling until she had lifted it up off the stake.

Like most animals, elephants are fond of rubbing against a tree, pole, or other object. But for such great beasts to rub against the menagerie center poles means disarranged lamps or even more serious damage. So they are commanded to stand by the poles and yet not to touch them. The latter part of the command is, of course, sometimes forgotten, and yet one is often obliged to marvel at their almost perfect memory and obedience. The following incident illustrates the intelligence and keen comprehension of this interesting mammal.

One evening in the South I was pacing up and down in front of the Robinson herd. The night was cold and I was trying to keep warm. Tom, a small bull with very long tusks, began rubbing against a center pole. The lamps at once commenced to swing as in a crazy dance. I shouted, "Tom, that pole!" He started to get away, but he was very slow and deliberate in all his movements, especially in doing things you asked him to do. Queen, a big cow who stood by him, put her head against his flank and gave him a push that landed him well away from the pole. She was not very obedient herself, but she knew what I wanted him to do and saw that he did it.

We fed the herd a mash of bran and oats once or twice a day, placing a pile of this food between each pair of elephants. Tillie and Queen, the two largest members of the herd, stood together. Almost invariably Tillie would divide the pile, quite equally and fairly, pulling her share over closer to her. But when Queen was looking the other way, she did not scruple to reach over and take a handful (or trunkful) off Queen's pile.

Most of the elephants with the Robinson circus were trained animals and I have seen them in the winter quarters at Terrace Park, Ohio, going through their acts without any human assistance, apparently for the mere pleasure of the exercise or to relieve the monotony of life in the building. The elephant house was built against a low hill; the windows on that side were high in the wall. I have seen them get up on their hind feet to look out of these windows.

As with many forest-loving animals the eyes of the elephant are not good for long range. But the senses of smell and of hearing are very keen. I was in the elephant house at the Wallace winter quarters at Peru, Indiana, one winter

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ENLISTED AS A STREET CLEANER

During a heavy snowfall some years ago in Bridgeport, Connecticut, elephants of the Barnum and Bailey Circus were harnessed to snow plows. They not only performed an important civic duty but gave the children of the community many delightful free rides afternoon. The herd was feeding on corn fodder, making a loud, rustling sound as they handled the stalks and dry leaves. Presently there was some strange noise outside, not loud but peculiar and unusual. Instantly the rustling ceased. Every one of the great beasts was standing perfectly still, the great ears thrown out, listening. For fully a minute absolute silence reigned. Then, as the sound was not repeated, they went back to their fodder.

The rhythmic, pendulum-like swinging from side to side, so common with elephants in captivity, I have always considered an effort to relieve the monotony of standing in one spot for long periods of time and to obtain some exercise. I do not remember ever to have seen an elephant indulge in this practice when he was not chained fast. It is a common belief that in throwing dirt over his back the elephant is trying to protect the sensitive parts of the skin from the bites of insects. But elephants do this in winter, when insects are rarely in evidence, as well as in summer. I am inclined to think the practice was begun as a protection against insects, but has been kept up for so many generations that it has become a fixed habit and is indulged in, almost unconsciously, at all seasons. Then, too, it may be a sort of dust bath, the dirt having a cooling or soothing effect on the skin.

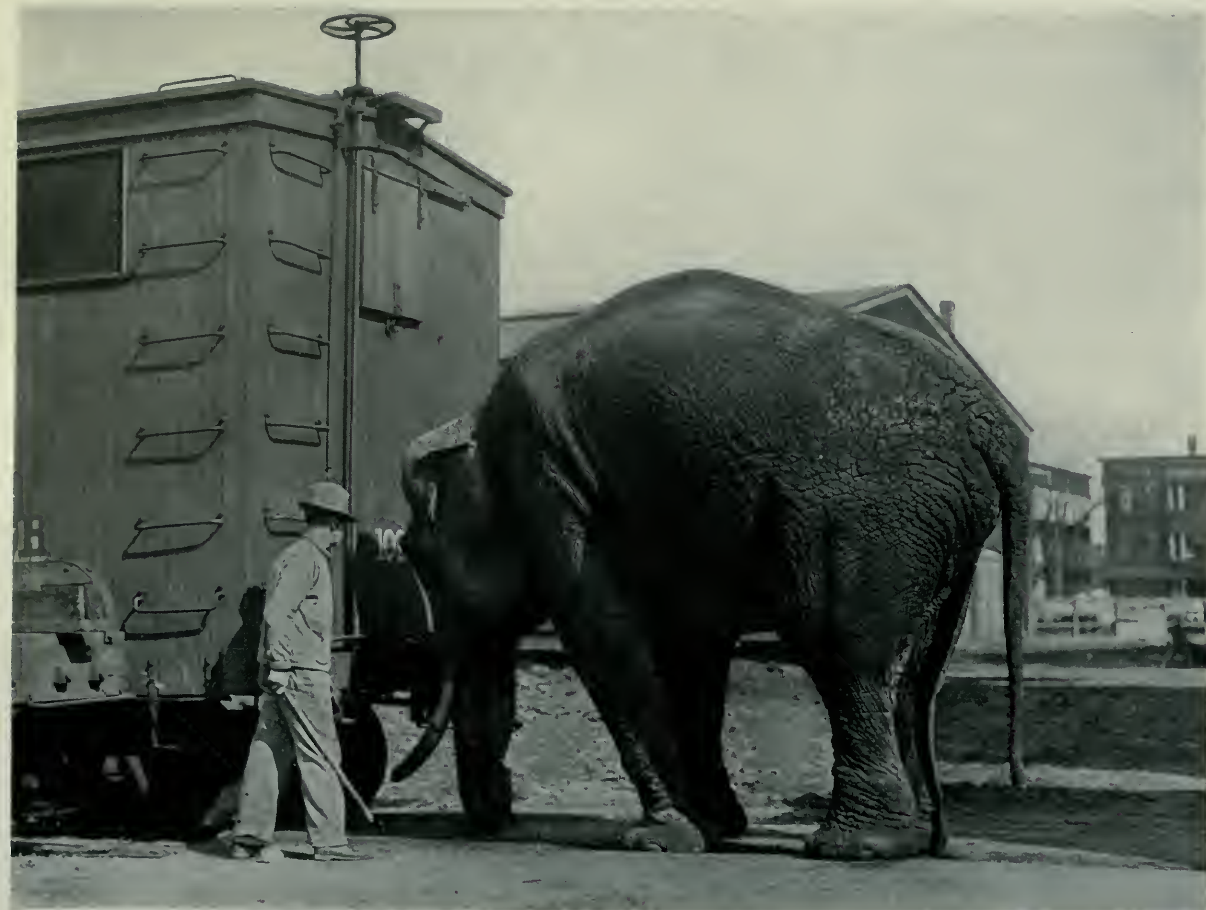
To illustrate the reasoning power of the elephant, *Chambers' Encyclopedia* relates the following incident. A tame elephant in India chanced to fall into a pit. There were some billets of wood and old lumber scattered over the bottom of the pit. He gathered these together and made a pile of them. Then mounting upon the pile he was able to make his escape.

Several years ago, when Dunk was still living, I visited the elephant house in the National Zoological Park. The floor of Dunk's enclosure was raised several inches above that of the front of the building. A peanut lay at the base of this raised floor and Dunk was trying to obtain it. But it was too close to the raised floor and he could not get hold of it. After a little he put his trunk down near the peanut and blew a gentle blast, rolling it out where it was easily accessible.

Dunk was the only elephant I ever knew who, having "gone bad" in a traveling menagerie, regained his good disposition in a park. Usually when an elephant "goes bad," he is bad ever afterward. Bolivar, of the Philadelphia garden, and Chief, of the Cincinnati garden, are conspicuous examples. Chief became more and more wicked after he entered the garden, until he had to be put to death.

When I was with the Ringling menagerie, we had a large female that we used as a pushing elephant. One morning the assistant superintendent used her to push a heavy wagon across a soft lot. But the harder she pushed, the deeper the wheels went into the sand. She stepped back, her little beadlike eyes on the heavy vehicle, and seemed to be meditating upon the problem. Then she reached down with her trunk, took hold of one of the wheels, and gave a strong lift, at the same time pushing forward with her head; the wagon moved out of the rut.

The passions of fear, hatred, jealousy, and love are all keenly developed in the elephant. Although he is brave to face any danger he understands, no animal so quickly takes to flight at some unusual sight or sound. At Morrelton, Arkansas, I was riding in the howdah on Tillie in the street parade. The lot where our encampment was located was about a mile from the town and the road to it followed the railway, the latter being elevated on an embankment about ten feet above the public thoroughfare. A crowd of people climbed to the railroad to look down on the parade as we went back. As usual, the elephants were bringing up the rear. We had got about half way back to the lot when an engine



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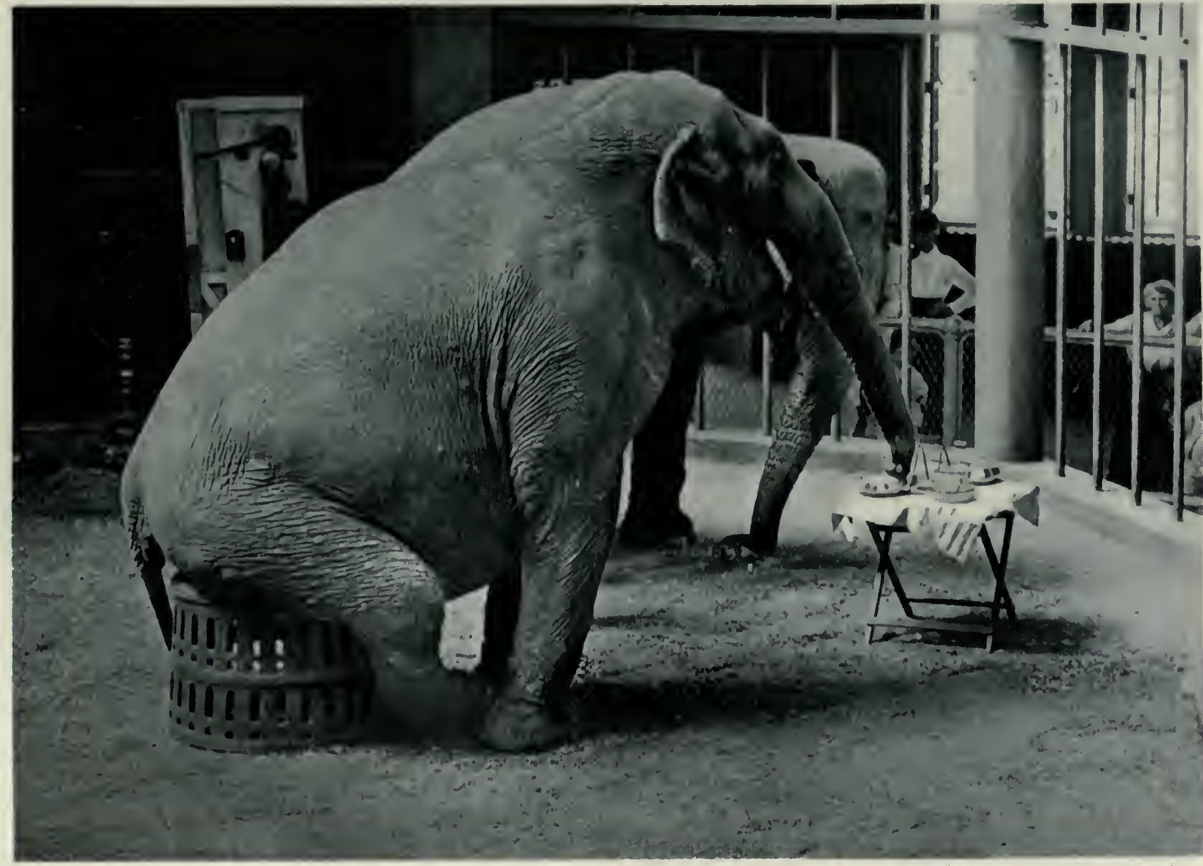
A SUBSTITUTE FOR A LOCOMOTIVE

In India, Burma, and Siam, as is well known, the elephant is used in logging operations, proving a tractable and intelligent co-worker with man. The employment of this animal on the railways of our country is a practice that strikes one as bizarre and manifestly it is a practice that can never become general. Nevertheless, it suggests one of the uses to which this adaptable animal may be put in emergencies, and indeed pushing-elephants are of service to circuses under all conditions. With his head lowered, his weight thrown forward, his whole attitude intent upon the task in hand, this heavy jungle creature is about to match his strength against a resistant freight car. That the freight car will yield before him there can be little doubt, for when the elephant exerts his strength, even brick walls yield to his pressure. In a combat that occurred thirty years ago between two elephants housed in the Wallace winter quarters, one pushed the other through a solid brick wall fourteen inches thick



AFTERNOON TEA

As a pet the elephant is rather unwieldy and yet in spite of his potential strength and his air of gravity, he will perform stunts as docilely as a house dog bent on pleasing his master. Usually it is only in the circus ring that these massive quadrupeds are put through their repertoire of tricks, but occasionally inmates of zoölogical gardens offer entertainment of this character. An example is the afternoon tea party depicted here, representing a scene enacted at the Franklin Park Zoo in Boston.

Sometimes elephants that have "gone bad" in travelling shows are consigned to zoölogical gardens or parks. Though in their general disposition resembling the little girl who "when she was good, was very, very good," the elephant when he has once "gone bad" is apt to grow steadily more horrid. When the temper of such an elephant reaches the danger point, it becomes necessary to kill him approaching from behind began whistling as a signal for the people to get off the track. This threw the elephants into a panic and they started to run. One of the circus girls who was riding in the howdah with me jumped and screamed to me to do likewise. But I knew the safest place for me was on the back of that elephant, provided I could stay there. So I held on to the howdah with might and main. We soon quieted the elephants with soothing words and they stopped their mad flight. The race did not last long, but it was interesting while it did last.

When an elephant is badly scared, he becomes panic stricken and takes complete leave of his senses. Then he is likely to run over you, trample on you, or crush you against something. It was in this way that Lockhart, the famous trainer, was killed. He was loading one Sunday morning in London, when something frightened the herd. The elephants started to run through the railroad yards and Lockhart after them. A big bull, in mad terror, crushed him against the side of a car. But the elephant is ordinarily a very careful animal, and when not frenzied by fear, never hurts a man accidentally. I have walked around a circus ring for hours with elephants, giving them exercise, but do not remember that one of them ever touched my foot with his foot. But when a horse was put into the ring to accustom him to walk with elephants, the horse and I began at once to tread on each other's feet.

We once had a large female elephant that did an act with a very small pony. At one stage of the act the little pony would lie down in the ring and let the big pachyderm step over him. She was very much attached to the pony and was so afraid she might step on him that her extreme caution became humorous. She moved her feet so slowly that the trainer had to jab her with the hook to hurry her up a little.

The likes and dislikes of the elephant are very pronounced and these create some of the hardest problems elephant men have to solve. With the Robinson show we had a small female known as Queenie. Tillie, the star performer of the herd, was very much attached to Queenie, and if the latter made any noise while the elephant act was in progress, Tillie would break away and race back to the menagerie, with the whole herd at her heels. At Cumminsville, a suburb of Cincinnati, we had such a stampede, and the people lost their heads and rushed down on to the hippodrome track. The whole herd went through the crowd on the double quick without hurting a single individual, illustrating the exceeding carefulness of this, the largest of the world's land mammals. Some big strong man with a tent stake always had to be set to guard Queenie and make all sorts of dire threats as to what he would do to her if she dared open her mouth.

The elephant often becomes affectionately attached to his keeper and will fight for him. Tillie formed a close attachment for a nine-year-old girl belonging to one of the circus troupes. Every evening the child came into the menagerie, and the big beast would fold her trunk gently about her, fondle her, and express in many ways her liking. If any one approached the little girl, Tillie would step back and throw out her ears in a threatening attitude.

No animal is quicker to resent an injury or insult, or supposed insult. Charles Alderfer, now manager of the Alderfer Circus, began his life as a showman with the elephants of the Wallace menagerie. One day in winter quarters the head painter wanted some wagons moved and Alderfer volunteered to bring out an elephant. He brought out Pilate, notoriously surly in disposition. In backing one of the wagons, the pole, or tongue, struck Pilate on the side. He thought it was Alderfer's fault and started for him, his ears spread out like the sails of a yacht. The painter said for a few minutes he would not have given fifteen cents for Alderfer's life. The latter ran at top speed and jumped over a fence. Then he put the hook into Pilate, climbed back, led him to the elephant house, chained him up, and whipped him severely. Pilate apparently recognized the injustice of his suspicion for after that he was always the friend of Alderfer.

No animal hates more intensely, or avenges himself more cruelly on his enemy, be that enemy human or of his own species. In October, 1892, there was an exciting elephant fight at the Wallace winter quarters. It occurred on Sunday evening. The show had been in from the road only a few days. There were five elephants in the herd, four of them big bulls. After an early supper, the keepers left their charges, each chained to the floor by the left foreleg, and went to town. In some unaccountable way, four of the five elephants got loose. Pilate and Diamond had always had an antipathy for each other and at once began fighting. Their trumpeting made the night hideous. The lions and tigers in a near-by building added their roaring and screaming to the awful chorus, and the neighbors for miles around thought bedlam had been turned loose. The two vicious brutes fought savagely until Pilate had one of his tusks broken, whereupon Diamond put his head against his antagonist's side and pushed him clear through the outer wall of the building, a solid brick wall fourteen inches thick. They had gored each other until the building looked as if a river of blood had flowed through it. But, strange to relate, neither of them was seriously hurt and in a few days, barring Pilate's broken tusk, they appeared to be in as good condition as ever.

Courtesy of Mr. Herbert Lang

AN ADULT PELICAN SHADING HER NEWLY HATCHED YOUNG

Shade is a rare luxury on Bird Island, and while the nestlings are still very young and in a more or less naked condition, the parent bird spends much of the time shielding the little ones from the intense rays of the sun

BROWN PELICANS AT HOME

A VISIT TO BIRD ISLAND OFF THE COAST OF TEXAS

BY

ALVIN R. CAHN

About thirty miles south of Corpus Christi, Texas, there lies a tiny, crushed-shell island, some six miles off the coast. This wee speck of land, less than half a mile in length and a couple of hundred yards in width, rises out of the Laguna Madre, a long, narrow strip of water separated from the Gulf of Mexico by the equally long, sandy Padre Island, which plays the part of stolid protector with more or less success. True, Bird Island, as this spot of shell reef is known locally, is protected from the fury of the Gulf by the sand dunes of Padre, but even these fail in times of excessive impetuosity to stem the attack of the waters of the Gulf. At such times the waves rise in their fury, overwhelm Padre Island, and Bird Island and its unfortunate inhabitants are buried beneath twenty feet or more of wind-lashed ocean. Luckily, such catastrophes are infrequent, yet such a calamity occurred in the fall of 1919, in the big storm which caused such havoc at Corpus Christi.

It was with some doubt in my mind, therefore, that I made the journey to Corpus, *en route* to Bird Island, to see what I could see. To the inquiries I made in the city I received the answer that birds were nesting on the island, though certainly not in the numbers that had existed there previous to the big storm. The local game warden was sought, and his knowledge solicited. Yes, there was a Bird Island, though how large it was or what was on it he had not the slightest idea. Had he never been there? No, never; he had never had occasion to visit it. The germ of doubt, already in my mind, grew, but the timely discovery of the owner of a launch, a man who knew the island, brought the sun through the gathering clouds, and after hasty preparations, early on the morning of May 26, 1921, our little party of three placed its scanty equipment in the launch and, with the boatman accompanying us, headed for the isle of birds.

Down the water lane between Padre Island and the mainland we chugged. Ward herons flapped lazily overhead, carrying food to their nestlings, or stood watching us in motionless silence, "knee"-deep in the shallow lagoon. Schools of mullet, disturbed by the passing of the boat, broke water in a thousand little ripples, and just beyond the bow of the launch raced an undulating porpoise,—his great black back, rising and sinking in the water, suggestive of a gigantic chest breathing heavily. It was altogether enchanting, but the big question on my mind kept me uneasy: were the pelicans really breeding on Bird Island? I had never seen even a single wild pelican, and I had taken this trip in order to make the acquaintance of these birds, to interview them, and to bring my results back with me on the two hundred odd photographic films I was so carefully protecting from the dancing spray and the merciless sun.

Were the pelicans on Bird Island? My hopes rose when about noon three of the great brown birds flapped slowly by, going in a direction opposite to ours: flap, flap, flap, glide; then flap, flap, flap, glide again, skimming just above the water in single file, for all the world like three "youngsters" playing at "follow the leader." Shortly a group of seven filed soberly by, and then other little squads, all in single file, all with a flap, flap, glide, and all very sedate in flight. Bird Island was easily discernible now, though it looked infinitely far off on the horizon. I could see the trees, green against the spotless sky, and the glistening white beach extending to the water, all distorted by shimmering heat waves.

Overhead laughing gulls were screaming, and reddish egrets and Louisiana herons were winging to and from the main land. Now and then a pelican emerged from the direction of the island and went sedately about its business without as much as a glance at us. A pair of Mexican cormorants appeared quite suddenly, were visible for an instant just ahead of us, then dove quickly, and were not seen again. A vague murmuring was in my ears, a low whispering that was only half audible—an impression rather than a sound.

Then the engine stopped and a voice from the stern sang out: "All out for Bird Island." With a start I came out of my enchantment. From my position—flat on my stomach on the bow of the launch—Bird Island was still on the horizon, a shimmering phantom. I sat up to see what the joke was, and lo! there was the island, not a quarter of a mile away! The beach? Yes, it was true enough. But the trees? Not a sign of anything that stood any higher than a little clump of sunflowers was discernible. Bird Island rose less than a foot out of the sea! Over the side of the boat we went, waist-deep into the refreshing coolness of the water. The equipment was loaded into the rowboat we had towed for the purpose, because the laguna was so shallow that we could land at the island only in a small boat. Two great cans of drinking water, our rations, charcoal burner, blankets, cameras, and the one little tent that was to protect the food and photographic material from the inevitable sun and the possible showers,—all were shifted into the little rowboat, and we were ready to go ashore. Then it was that I persuaded the boatman, though with difficulty, that I was indeed serious when I said I wanted him to come back and call for us on the *sixth* day. Unheard of! No one spent more than one night on Bird Island. I suspect he thought us entirely out of our minds to propose spending six whole days and nights on that treeless, shelterless, uninhabited (from his point of view), sun-baked reef. And it was with the guess that we would be mighty glad to see him when he *did* come—a guess that was wholly wrong—that he started the engine again, and turned the nose of the little launch back toward Corpus. Bird Island was ours.

The dull murmur that I had heard grew louder as we waded slowly shoreward, and became distinguishable as the voices of a myriad birds—a great singing and cackling, like that of a huge, well-stocked poultry farm. Louder and louder it grew. Laughing gulls were circling over our heads in constantly increasing numbers, darting at us, shrieking and scolding at a great rate. Then, with the grounding of the boat on the beach and the appearance of three dripping figures emerging from the sea, pandemonium broke forth in earnest, as wave after wave of gulls rose from their nests and circled, screaming, over the island.

During the days that followed—cloudless, blistering days—I studied the life on the little island and photographed its various inhabitants. Ward herons, reddish egrets, Louisiana herons, royal terns, laughing gulls, black skimmers, and many other interesting species gradually became accustomed to our wanderings, and the disturbance caused by our coming and going became less and less as the days sped on. But the birds I had come to interview were the brown pelicans, and I found them nesting safely on the far end of the island, isolated from all the other species of birds except an occasional egret or heron that ventured to nest at the outskirts of the pelican village.

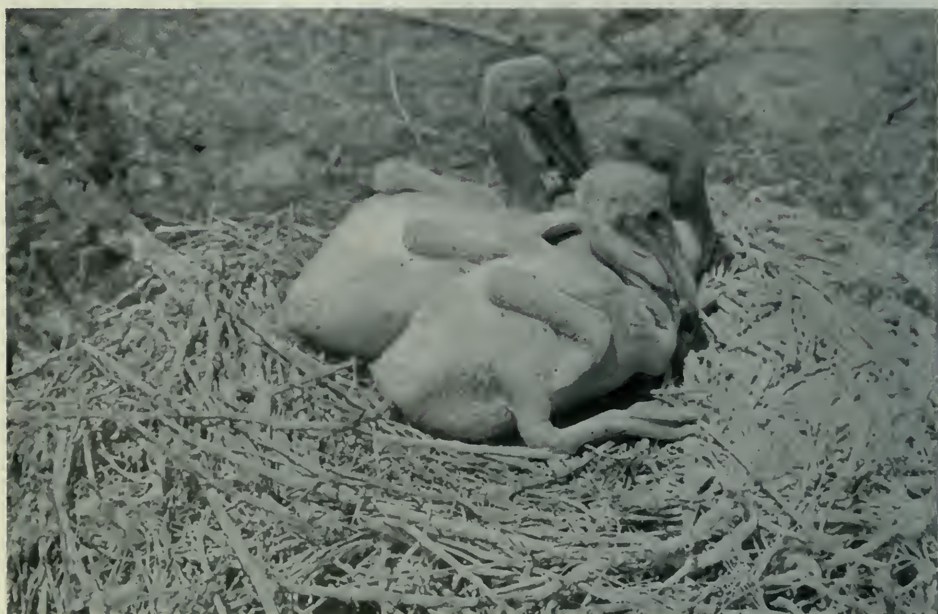
I think it would have been impossible to have visited the island at a more opportune time. Nests in every stage of development were there—from those containing a single, fresh egg to those that had already been deserted by the successfully hatched young. The whole story of the pelican's breeding habits lay before me, recorded in hundreds of nests. As seen from the distance, the pelican rookery had the appearance of the ground in early spring, covered with the last remnants of a spring thaw—patches of snow here and there, which proved in reality to be great flocks of young pelicans in their white, downy plumage. Great, heavy-winged birds flapped overhead, turning their awkward heads from side to side as they eyed first with one eye and then with the other the impudent invaders of their solitude. The only sound they made was the swish of their strong wings. Several times they circled over the source of the disturbance: then, if all appeared safe, they returned to their nests; if in doubt, they dropped into the water and philosophically preened their feathers with their huge bills, apparently quite unconcerned.

The pelican nest consists of a great mass of sticks, twigs, seaweed, and other matter, with a large depression in the top to hold the eggs. This depression is usually unlined, but some nests were found which had some dry seaweed placed as a lining to protect the eggs and young. The pelican egg is very hard and thick-shelled, with a heavy, chalky surface of dull white. The average number of eggs to a nest was, according to my observation, three, and these settings were found in all stages of incubation. In one nest lay eggs that were perfectly fresh; three feet away in a neighboring nest a newly hatched pelican was just extricating itself from the confining limits of the shell for which it had no further use, while back and forth between the two nests wandered fledglings already showing the appearance of the black primaries in their wings. Here was luck indeed! In an hour I might photograph almost every stage in the adolescent period of the pelican's life.

A young pelican just out of the egg

The young pelican, on emerging from the egg, is certainly a homely little creature: black-skinned, absolutely naked, with a great head, heavy bill, and large, bulging eyes, a pelican baby is about as grotesque a creature as the imagination can draw. Entirely helpless, its head too heavy to be raised for more than a trembling second, this baby is

Whole fish are sometimes deposited in the nest for the young birds to pick at. Fish is the natural diet of the pelican from the nestling stage through adult life



Soft, white down appears, and soon covers the naked bodies of the young birds

THE YOUNG ARE VERY AWKWARD, AND CERTAINLY NOT PRETTY

GATHERED FOR THE BANQUET

On her return from a fishing trip an adult pelican is almost mobbed by hungry youngsters

A COMPACT GROUP OF YOUNG BIRDS

As soon as they are able, the young birds wander about, but at first they return to the nest periodically to be fed

THE YOUNG FEEDING FROM THE POUCH OF THE OLD BIRD

THE OLD BIRD ABOUT TO SPRING INTO THE AIR indeed a sight to call forth pity. Incubation is lax among the pelicans on the island; the May sun is so hot that the old birds can leave the nest for long periods without danger of the eggs being chilled. This laxity is, however, often fatal to the babies, for if they are unfortunate enough to choose a time when their parents are absent to emerge into this great world of ours, they are more than likely to die of sunstroke before their parents return. But the death of the babies does not seem to worry the old birds in the least. The pelican is evidently a fatalist and takes life very philosophically—worries about nothing, apparently, never gets excited, makes the best of what is, and never for an instant forsakes its dignity. One can not help wondering what a pelican thinks about.

As they grow, the young become more homely still, if such a thing be possible, but the appearance over the body of little tufts of white down eventually improves their looks somewhat. The great meals of regurgitated fish which the young bird obtains by inserting its little head deep into its parent's throat, result in a growth that is surprisingly rapid. Fish is the natural diet of these birds; it is about all they eat during their lifetime. Perhaps that is why they appear so thoughtful! About the time they are completely covered with down they are able to sit erect, and with their funny little wings pressed close to their plump little bodies they look for all the world as if they were doing their regulation calisthenics,—their "setting-up" exercises. Their legs are still too weak to hold the weight of their bodies, and they sit on their "heels," usually in contact with one another, which helps somewhat to support them. As soon as their legs will hold them, they have a tendency to "go on explores," flopping over the side of the nest and starting for a walk. These early walks are most comical. The youngster staggers doggedly along, falls over everything, tangles itself up in every stick and vine, and has a terrible time generally. However, when it has had enough, it returns to its nest and climbs back in again, using legs, wings, and beak in making the ascent. As the birds get older and stronger, their wanderings are of longer duration, and they return to the nest less frequently, eventually joining the large wandering colonies of youngsters that have already outgrown the nest. These great groups of young pelicans simply stray aimlessly about in a very limited space and wait to be fed. The only sound they make is a hissing one, with which they hope—evidently with not too much confidence of success—to frighten you away. When an old bird returns from a fishing expedition, it is mobbed by a wild mass of hungry young, each one of which is eager to get down into the pouch first. How the old bird defends itself against the attack! Crack goes the bill as it hits the nearest youngster over the head. Then crack and crack again as the dazed babies stagger away. There is no disposition to underestimate the blows: they are well aimed and heavily delivered. And if a baby is too persistent in its efforts to get the food, a sad case of cannibalism is likely to follow. Yet out of this mass of babies one is eventually fed, and who can say whether or not it is the adult bird's own offspring. To our eyes the babies all look alike. Still, the instincts of parents are beyond understanding!

When not out fishing or drifting on the water, the old birds spend much of their time "just standin' round," doing nothing. Occasionally they play with their feathers, straightening them out and preening them. Occasionally, too, one stretches its great neck upward and performs the strangest yawn imaginable. When a wandering baby comes too close, the old bird becomes irritable and whacks it viciously with its bill, so that the youngsters are constantly "running the gauntlet." Upon leaving the nest the pelican rises to a standing position, spreads its great wings, crouches, and

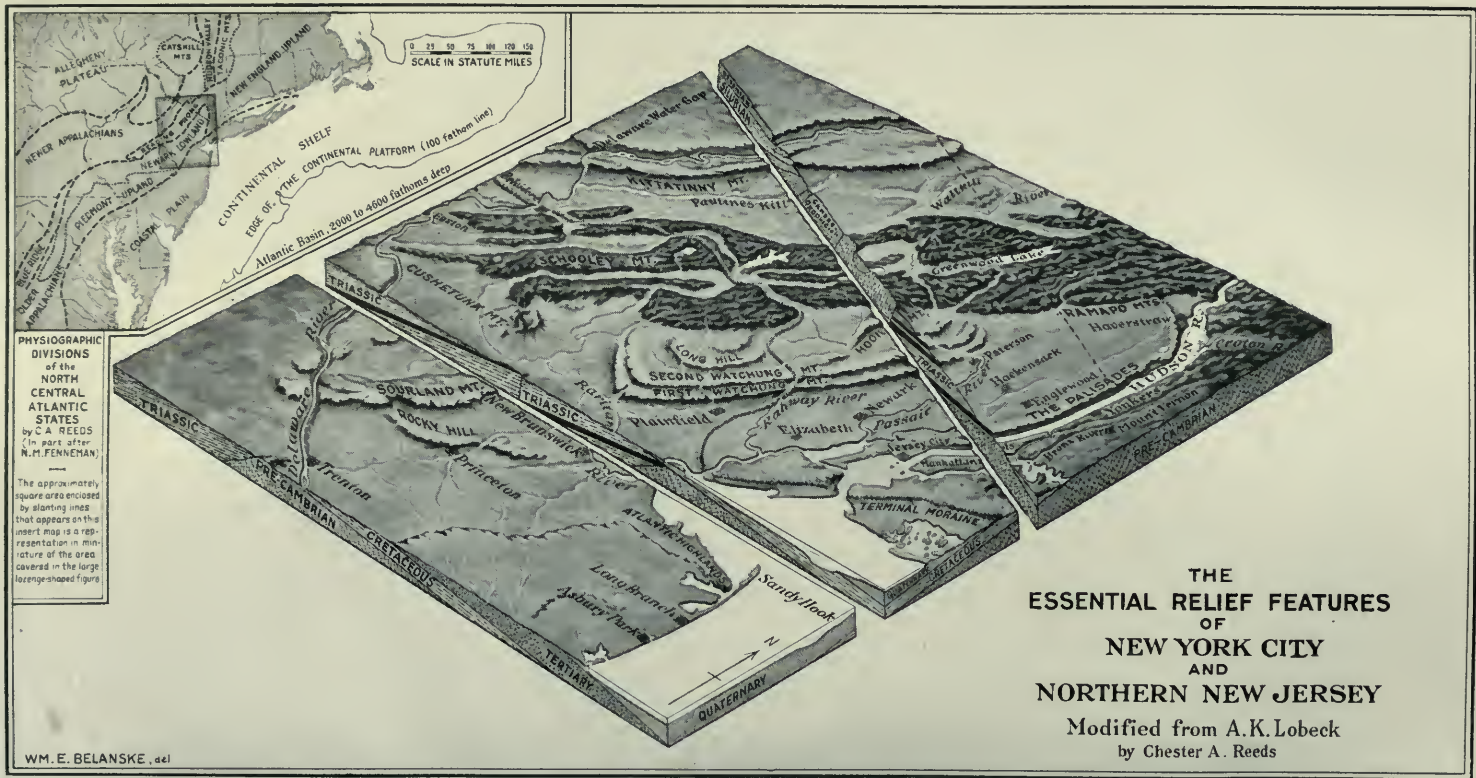
PORTRAIT OF A YOUNG PELICAN JUST ABLE TO WALK

A PELICAN PORTRAIT

then launches itself into the air with a great spring. On returning to the nest the bird sometimes alights on the edge, placing its great feet often within a couple of inches of the tiny baby with an accuracy and confidence that is surprising in a bird of such awkward appearance and such great bulk. While the babies are still very young and in the more or less naked condition, a good part of the time is spent by the old birds in standing between the sun and the young, giving them the blessed relief of shade—a luxury, indeed, on Bird Island. And yet how blind are certain instincts! Often my camera stood by the hour between the nest and the sun, in which case the old bird was entirely satisfied to stand on the *other* side of the nest, often with wings slightly spread to afford more shade, casting her great shadow on the bare ground, entirely content in her knowledge that she was doing her duty by her children!

When we first reached the island, the pelicans were very timid and would not permit close approach. However, as we wandered about day after day, this timidity decreased until only those birds immediately in our path arose, and even these returned to their duties almost at once. So the days fled. On the last day I tried an experiment: how close could I get to a wild pelican and secure a portrait? With this idea in mind I chose a nest easily approached—one which I could walk to with my head buried in my graflex camera and without dividing my attention between my feet and the bird. The first exposure I made at twenty feet, changed the film, and moved up. The old bird stood like a statue on the rim of her nest, the babies lying exhaused after a big meal. At fifteen feet I shot again, and again at twelve and at ten. Each time I moved slowly forward, making no sudden movements that might startle the bird into flight. Progress became slow now. Each time I stole a few inches forward, the bird spread her wings and crouched for a spring. I stopped, and the bird came back to rest. Again a few inches were gained. At eight feet another portrait: the image of the bird already covered the entire film. Slower and slower became my progress, and my every action was met with a definite reaction on the part of the bird. As long as there was no noise and no sudden movement, there seemed to be no limit as to how close I might approach. The noise of the shutter sounded to me like a clap of thunder. Surely, I thought, she will rise at the next exposure. Seven feet, and another portrait: just the head and neck now. Six feet! My back and arms ached with the tension of the last half hour, and the perspiration ran in little rivers down my spine. Forward again, infinitely slowly now. Almost within five feet of the bird! Suddenly the air was rent with a terrific explosion which took me so completely by surprise that I jumped. So did the bird, and the experiment was ended. The air was filled with a horrible odor. What on earth could have happened? I looked around, and there by my feet lay the remains of an ancient pelican egg whose tough shell had at last yielded to the internal pressure!

The launch returned shortly before noon, and it was with a feeling of regret that we packed up. And yet I was anxious to get back to the city: I could do no developing on the island, and so I had no idea how my pictures would turn out. Was I taking with me a photographic story of the life of the pelican, or was I packing back merely a batch of failures? I offer you some of the results herewith, and you can answer to suit yourself the question that was in my mind.



DIAGRAMMATIC RELIEF MAP OF NEW YORK CITY AND ADJOINING AREAS

GEOLOGY OF NEW YORK CITY AND ITS VICINITY

BY

CHESTER A. REEDS*

THE relief features of the New York City district consist of several distinctly different types, which have been developed by natural forces on rocks of unequal hardness. Some of the rocks are unconsolidated sands and muds and are of comparatively recent date; others are stratified with alternating hard and soft beds, which have been tilted or slightly folded and are older; still others of the same origin but far older have been so much altered and deformed during certain geologic periods that they have become crystalline and entirely changed in appearance, that is, metamorphosed. Volcanic rocks thick and homogeneous in character have also been injected into the area at different times, some very early, others later, but none very recently. These and some of the crystalline ones form the most resistant ridges. The distribution of the rocks is in the form of belts with a prevailing northeast-southwest direction.

The essential relief features and physiographic provinces of the area are shown in a graphic manner on the relief map, p. 430. They may be summarized as follows:

1. The continental shelf, which represents the submerged margin of the continent, extends eastward from the New Jersey shore for about 100 miles to the 100 fathom line. Beyond that point the sea floor drops rapidly to the great and extensive oceanic depths of 2000–4600 fathoms.

2. The Coastal Plain is that portion of the former submerged continental shelf which has been raised above the sea without apparent deformation. Three well defined elements of this plain appear:

(a) Its inner lowland, partly drowned in Long Island Sound, Lower New York and Sandy Hook bays, extends southwestward along the main railway lines through New Brunswick, Trenton, Philadelphia, Baltimore, and Washington;

(b) Its fall line features appear on the Delaware at Trenton, on the Schuylkill at Philadelphia, on the Potomac at the Great Falls above Washington, D. C., and on the James River at Richmond;

(c) Its cuesta forms the foundation of Long Island, the Atlantic Highlands, and the ragged front making up the hilly belt of southern New Jersey.

3. The Newark Lowland is a plain developed on inclined weak strata consisting of red sandstones and shales of Triassic age. The intrusive sheets of resistant volcanic rock form the prominent residual ridges known as the Palisades, Watchung, Hook, Cushetunk and Sourland mountains, and Long and Rocky hills.

4. The New England Upland is represented in the district by the Manhattan and Reading prongs. This upland consists of dissected and disordered crystalline rocks. The Manhattan prong extends down the east bank of the Hudson estuary from the Highlands to and including Manhattan Island. The north central portion of Staten Island is an outlier. The Reading prong extends as highlands from the gorge of the Hudson southwestward across New York and New Jersey to Reading, Pennsylvania.

5. The broad valley to the west occupied by the Wallkill and Paulins Kill is a part of the great Appalachian Valley, which extends from Birmingham, Alabama, to Lake Champlain. It is one of the prominent subdivisions of the Newer Appalachian physiographic province.

6. The narrow Kittatinny Mountain ridge dipping westward, represents the northeastern extension of the belt of

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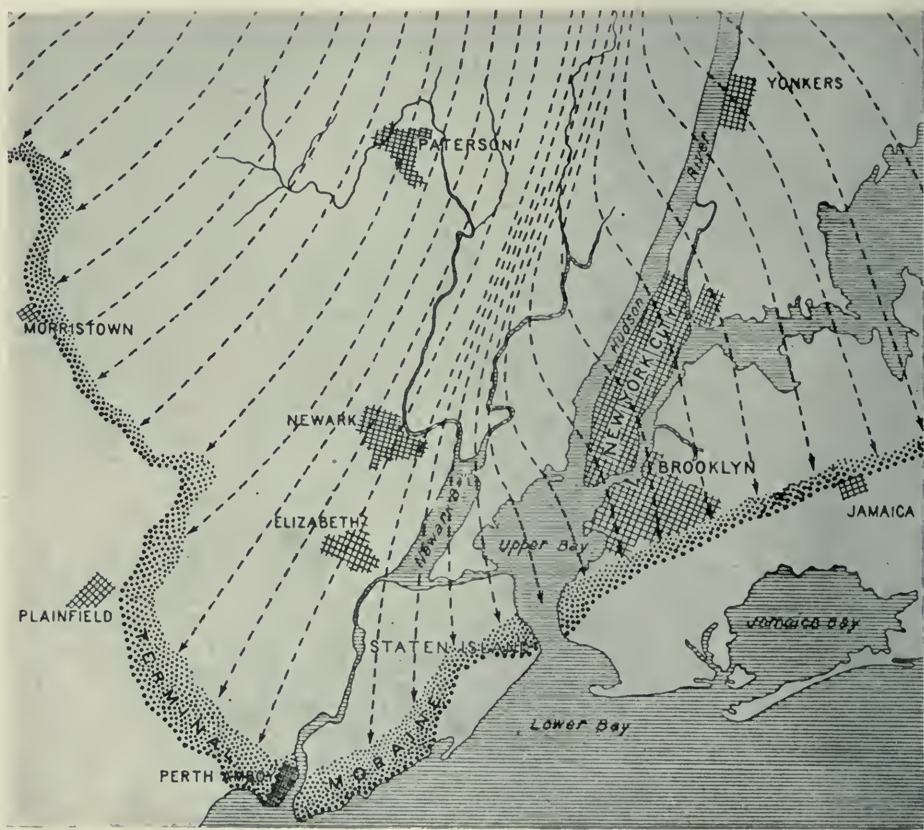


Sketch map of New York City and vicinity, showing position of the terminal moraine and directions of the ice movement (indicated by the arrows) during the last or Wisconsin glaciation. After United States Geological Survey

newer and folded Appalachians of central Pennsylvania.

7. The Alleghany Plateau appears west of the Delaware River. Farther north in New York State the Catskill Mountains represent a subdivision of this plateau.

Glaciation: The northern portion of the New York City district has been traversed at least four times by great sheets of ice which moved down from the Labrador center. These continental glaciers modified the drainage and the surface of the land over which they passed. The terminal moraine which represents the southernmost extent of the last ice field appears as a conspicuous ridge consisting of knobs and kettle holes on Long Island, Staten Island, and New Jersey. It continues westward across the United States to the Pacific Ocean near Seattle, Washington.

The drift bowlders and unsorted rock débris in the terminal moraine and northward give a clue as to the direction of ice movement. Large bowlders of crystalline rock from Jamaica and Hollis, Long Island, indicate that they were plucked out of the bed rock in the vicinity of Yonkers, Mt. Vernon, and other places in Westchester County, New York. Glacial-borne pebbles containing fossils and oolites have been found at Broadway and 191st Street. The fossils represent minute fragments of bryozoa and corals, of Devonian age, which are similar to those found at present in the Catskill Mountain region. The oolites, which

The "rocking stone," New York Zoölogical Park, an ice-transported bowlder resting on a glaciated surface

are small, concentric spheres cemented together, resemble fish roe. They, too, came from up-state New York. On Staten Island, Long Island, and Short Hills, New Jersey, many large drift bowlders of sedimentary origin and containing numerous marine fossils were derived from the exposures in east central New York State.

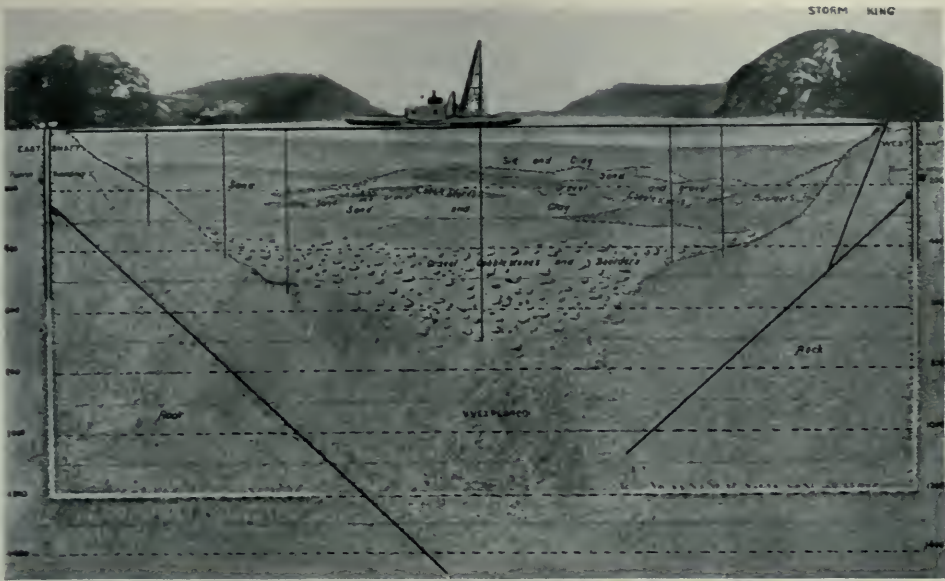
Each of the four continental glaciers of the Pleistocene epoch consisted of ice thousands of feet thick. They not only plucked out huge bowlders the size of a house and transported them long distances, but they also scoured off the soil-cover in many places and left bare rock surfaces, *roches moutonnées*, little deserts in fact, on which no plants other than lichens can grow. A good example of a glaciated surface with an ice-transported bowlder resting upon it is the "rocking stone" in the New York Zoölogical Park, Bronx, figured above.

Rocks held firmly in the base of the ice served not only as abrasives but also as etching tools. Deep parallel grooves in crystalline rock appear at various places on Riverside Drive, particularly on the south side of the Drive where it leaves the Hudson River at about 200th Street. These glacial striæ running northwest-southeast give the direction of ice movement. Many diabase bowlders from the Palisades found in Yonkers and New York City indicate that the ice moved southeasterly, diagonally across the Palisades and the Hudson River, as shown on the diagram.

A stream leaving the front of the glacier oftentimes contained a large volume of water and had considerable transporting power. Hence pebbles,

Exposure of glacial till, containing sand, gravel, and bowlders, in contact with Serpentine rock, at Castle Point, Hoboken. After United States Geological Survey, Passaic Folio, No. 157

sand, and fine rock débris were carried in considerable quantity. In most instances the streams deployed fanwise almost immediately on their emergence from the glacial sheet and the material carried from the ice was dropped close to the margin of the glacier. The fans formed by single streams were usually small, being from half a mile to two miles in radius; confluent fans were larger, varying from one to six miles in radius. The materials are somewhat sorted and stratified and are called outwash deposits. These deposits occur at short intervals along the southern margin of the terminal moraine. Towns built



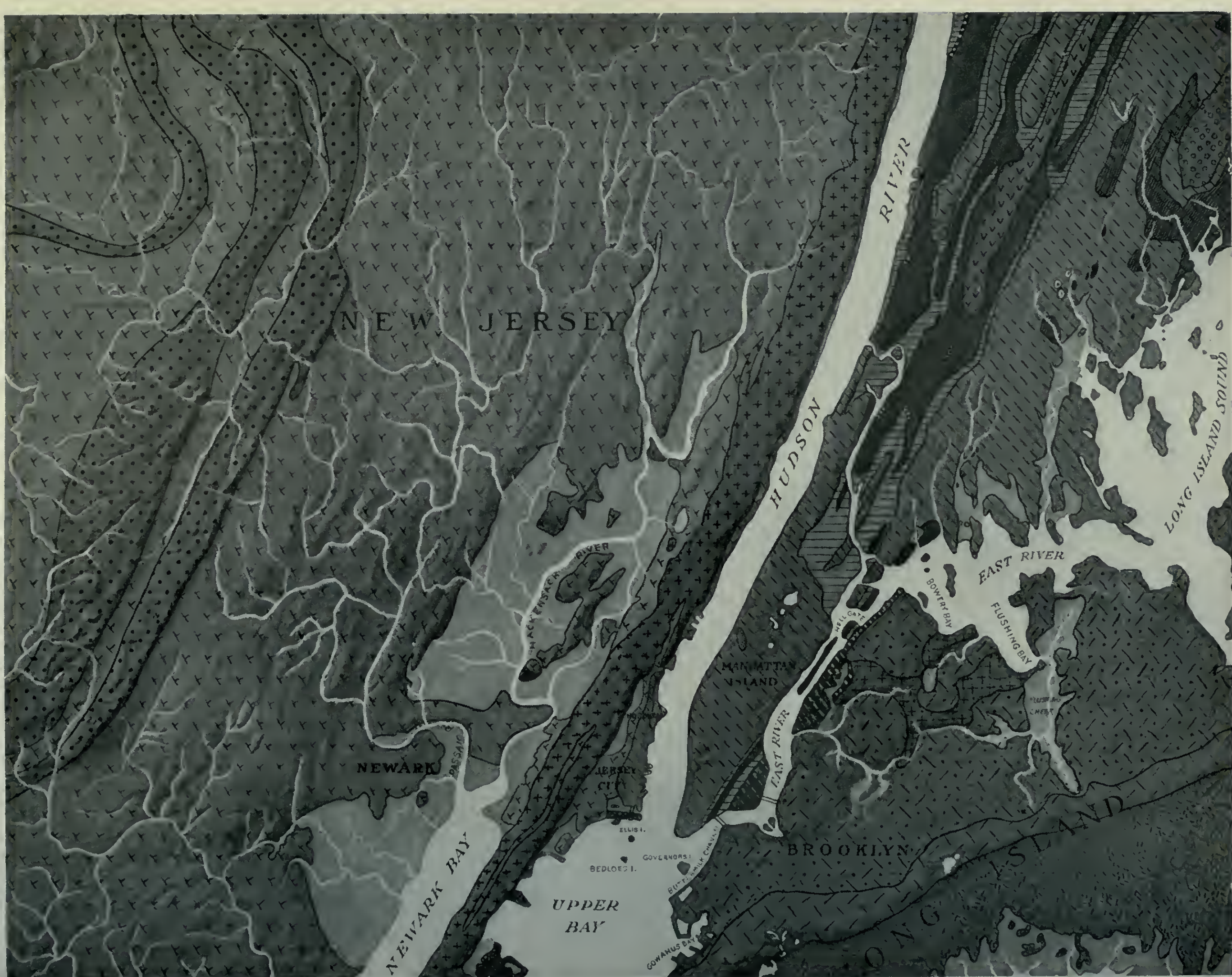
Cross-section drawing of the sediments in the Hudson River at Storm King Mountain, where is located the great siphon of the New York City aqueduct. From *Bulletin 146* of the New York State Museum

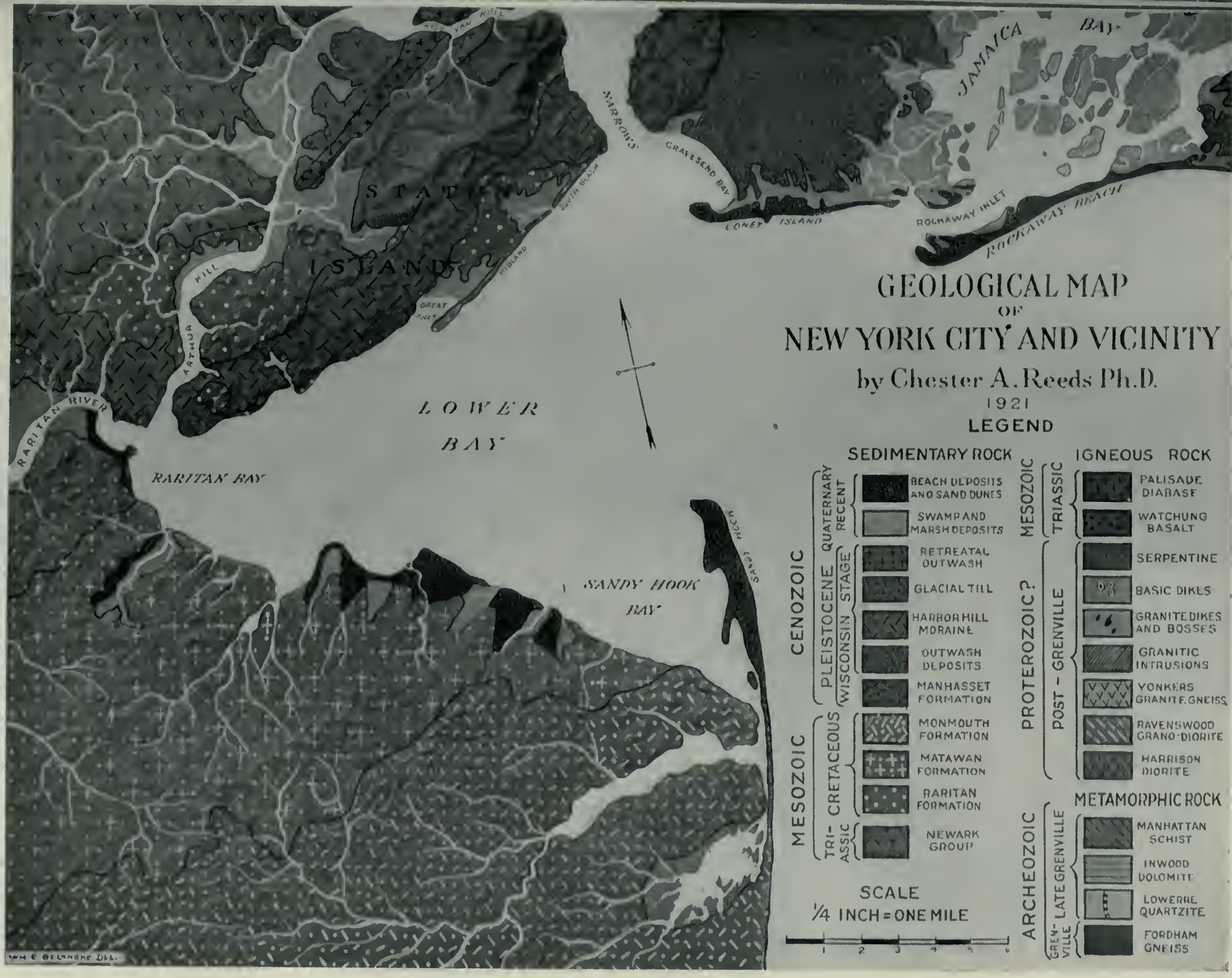
on some of the larger outwash plains are Plainfield, New Jersey; Flatbush and Hempstead, Long Island.

While glacial streams were depositing fan-shaped outwash deposits in many places along the ice front, a glacial lake, Lake Passaic, appeared to the south of the terminal moraine between the crescentic outline of the Watchung Mountains on the east and south and the New Jersey highlands on the west. The waters of the lake drained through the Muggy Hollow outlet at the southwest corner into the Raritan River valley. When the ice front retreated northward, the lake waters followed it and occupied the entire basin behind the Watchung Mountains to the west and southwest of Paterson, New Jersey. The numerous fresh-water marshes of today, along the upper course of the Passaic River, cover portions of the bed of this former glacial lake.

Great accumulations of glacial till, a mechanical mixture consisting of unsorted clay, sand, pebbles, and small bowlders, are found generally in the wake of the glacier. In the New York City district it varies from a fraction of a foot to 500 feet in thickness. A good exposure of it resting on Serpentine rock may be seen at Castle Point, Hoboken, New Jersey, p. 434. It oftentimes fills the pre-glacial stream valleys and frequently covers the leeward side of hills and the lower areas. Test holes in the Harlem River at High Bridge show that the channel has been filled up from 80 to 111 feet by glacial drift and river mud.

The glacial drifts and sediments in the Hudson River gorge at Storm King Mountain have been found by drilling operations to be between 768 and 995 feet thick, with an average of 800 feet. In the vicinity of the Pennsylvania Railroad tunnels at 32nd Street, New York City, the sediments are 300 feet thick, with a possible greater depth in an untested section in midstream. In the Lower Bay deposits accumulated to such an extent that the mouth of the river was almost closed to large ships. Some \$4,000,000 have been spent by army engineers in dredging the Ambrose Channel 2000 feet wide by 40 feet deep,


NEW JERSEY
HUDSON RIVER
LONG ISLAND SOUND
EAST RIVER
BOWERY BAY
FLUSHING BAY
HELL GATE
MANHATTAN ISLAND
EAST RIVER
HACKENSACK RIVER
NEWARK
PASSAIC
JERSEY CITY
ELLIS I.
GOVERNORS I.
BEDLOES I.
UPPER BAY
NEWARK BAY
GOWANUS BAY
BROOKLYN
LONG ISLAND


GEOLOGICAL MAP
OF
NEW YORK CITY AND VICINITY
by Chester A. Reeds Ph.D.
1921
LEGEND
SEDIMENTARY ROCK
CENOZOIC
QUATERNARY
RECENT
BEACH DEPOSITS AND SAND DUNES
SWAMP AND MARSH DEPOSITS
PLEISTOCENE
WISCONSIN STAGE
RETREATAL OUTWASH
GLACIAL TILL
HARBOR HILL MORAINE
OUTWASH DEPOSITS
MANHASSET FORMATION
MESOZOIC
CRETACEOUS
MONMOUTH FORMATION
MATAWAN FORMATION
RARITAN FORMATION
TRI-ASSIC
NEWARK GROUP
IGNEOUS ROCK
MESOZOIC
TRIASSIC
PALISADE DIABASE
WATCHUNG BASALT
PROTEROZOIC?
POST - GRENVILLE
SERPENTINE
BASIC DIKES
GRANITE DIKES AND BOSSES
GRANITIC INTRUSIONS
YONKERS GRANITE GNEISS
RAVENSWOOD GRANO-DIORITE
HARRISON DIORITE
METAMORPHIC ROCK
ARCHEOZOIC
LATE GRENVILLE
MANHATTAN SCHIST
INWOOD DOLOMITE
LOWERRE QUARTZITE
GREN-VILLE
FORDHAM GNEISS
SCALE
1/4 INCH = ONE MILE
1 2 3 4 5 6
JAMAICA BAY
NARROWS
GRAVESEND BAY
CONEY ISLAND
ROCKAWAY INLET
ROCKAWAY BEACH
STATEN ISLAND
ARTHUR KILL
LOWER BAY
RARITAN BAY
RARITAN RIVER
SANDY HOOK BAY
SANDY HOOK
GREAT KILLS
MIDLAND
SOUTH BEACH
KILL VAN KULL

so that the large ocean liners and other vessels may enter the harbor. From a point ten miles out from Sandy Hook to the edge of the continental shelf about one hundred miles distant, a well-defined river channel exists which increases in depth seaward. Near the brink of the continental platform it is 4800 feet deep. Glacial deposits appear over a portion of the course.

Recent Shore Deposits: Sandy Hook, Coney Island, and Rockaway Beach are pronounced coastal irregularities. South Beach and Midland Beach, Staten Island, are less so. These features are temporary for they represent initial stages in the process of coastal simplification. After the initial reefs and barriers have become land, the lagoons behind them are likely to be filled with sediment and organic matter, forming land.

The development of curved spits and beaches along the New Jersey and Long Island shores is worthy of consideration. In the vicinity of Long Branch, New Jersey, the sea cliff indicates wave erosion. The eroded débris is shifted northward by the waves and currents and piled up along the beach which terminates in Sandy Hook. The tendency of the hook to turn westward is due largely to the strong westward sweep of the winds and tides of the Atlantic Ocean. This has been going on for some time, for Sandy Hook is a compound, recurved spit. Rockaway Beach is also compound in appearance while Coney Island is simple. The same forces which drift the sediments north along the New Jersey shore are moving them westward along the Long Island coast in the vicinity of Rockaway and Coney Island. As Staten Island lies across the path of these waves, South Beach and Midland Beach represent a barrier or bar which has been built up by the waves near the line of breakers. That the prevailing direction of currents along the Midland Beach is to the southwest is indicated by the development of a spit in the vicinity of Great Kills. Beach deposition and straightening of the coast line is also in progress on the south shore of the Lower Bay in the vicinity of Port Monmouth, New Jersey.

The estuaries and lagoons east of Port Monmouth are being filled with sediments derived from the land and the growth of vegetation, for, being in the lee of Sandy Hook and the barrier beaches, they are protected from strong sea waves. This is also true of Jamaica Bay, the Flushing Creek basin, Hackensack Meadows, Newark Bay, and the upper reaches of Arthur Kill. These bays and estuaries are the result of recent subsidence of the area. Thus the drowned lands, which now represent shallow sea floors, have been a factor in the placing and development of certain pronounced hooks and barrier beaches. The wind has also notably modified the deposits made by the waves and currents, for it has developed long ridges and sand dunes on the surface of the beaches.

In addition to the shore deposits which are of recent development there are rocks exposed in the New York district which have greater age and a more profound history. There are at least five series of them. While they are in close juxtaposition and have a well-established relation to each other, they are widely separated in origin by great intervals of time. Each series has had its normal period of development; the oldest, however, has suffered greater physical and chemical changes imposed upon it by mountain-making movements and other deformations which have affected it during the growth of the North American continent.

In passing from a consideration of the present shore developments to the oldest series of rocks exposed in the area we go rapidly backward from the Age of Man through the Age of Mammals, the Age of Reptiles, the Age of Amphibians, the Age of Fishes, the Age of Invertebrates, to the little-known but inferred Age of Unicellular Organisms. We shall not take the opportunity to note the ever-changing shore line, the configuration of the lands and seas, and the great accumulation of sediments which have taken place slowly and repeatedly during these ages. We shall have to omit a discussion of the birth, rise, decay, and disappearance of mountain ranges which have succeeded one another in this and other parts of the continent. Standing on the threshold of the better known eras of geologic time, beginning with the Archæozoic, and turning our back on the hypothetical æons through which the earth must have already passed, let us approach the Present from the chronological point of view.

THE ARCHÆOZOIC ERA: In the dawn of life a series of limestones and associated sedimentary rocks were laid down in Canada near Ottawa, which have been called the Grenville series. According to Professor Berkey, of Columbia University, certain metamorphosed rocks in the Manhattan and Reading prongs of the New England upland are contemporaneous in age. The Fordham gneiss exposed in the Bronx and Westchester counties and northward has all the physical characters of the Grenville series. It consists primarily of granitic and quartzose black and white banded gneisses and schists of very complex composition and structure. Interbedded quartzite and limestones and old igneous intrusions are also included. Note the position on the accompanying geologic map, pp. 436-437.

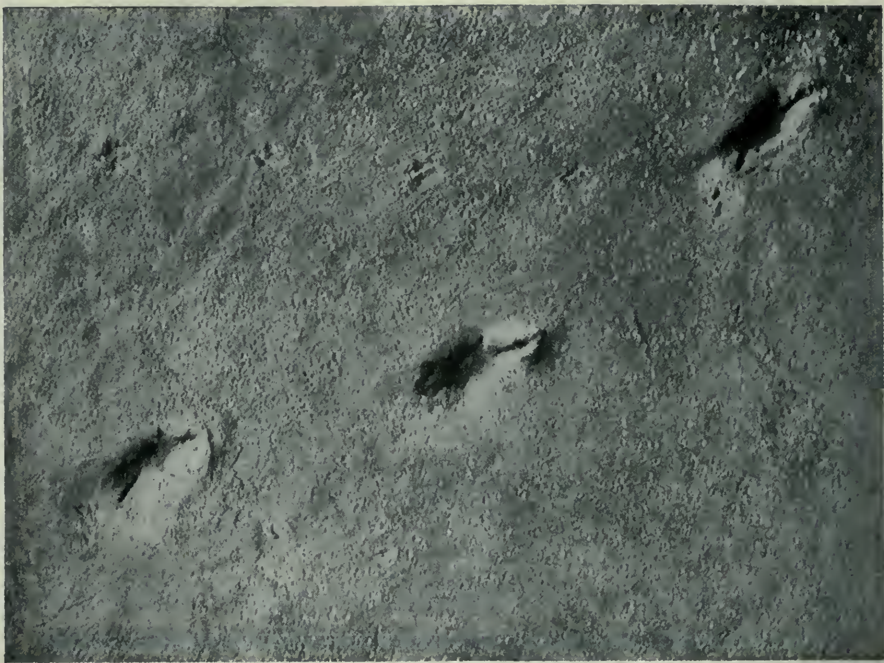
Overlying the gneiss series in a conformable manner at certain localities is the Lowerre quartzite named after the locality in South Yonkers from which it was first described. It is a thin, schistose quartzite which varies in thickness from a fraction of a foot to 100 feet and rarely out-crops.

This formation is followed by a coarsely crystalline limestone locally tremolitic, micaceous, and pegmatitic, which varies in thickness from 200 to 800 feet. It is called the Inwood dolomite after the Inwood section of the city at the north end of Manhattan Island. Good exposures of the Inwood dolomite occur in the valley north of Dyckman Street, for instance at Marble Hill station on the New York Central Railroad.

Conformable and overlying the Inwood formation is a coarsely crystalline mica schist, very thick, and pegmatitic, which is called the Manhattan after the extensive exposures on Manhattan Island. The Lowerre-Inwood-Manhattan series is regarded as late Grenville in age. This and the Fordham series constitute the originally sedimentary beds of the Archæozoic Era exposed in the New York City district.

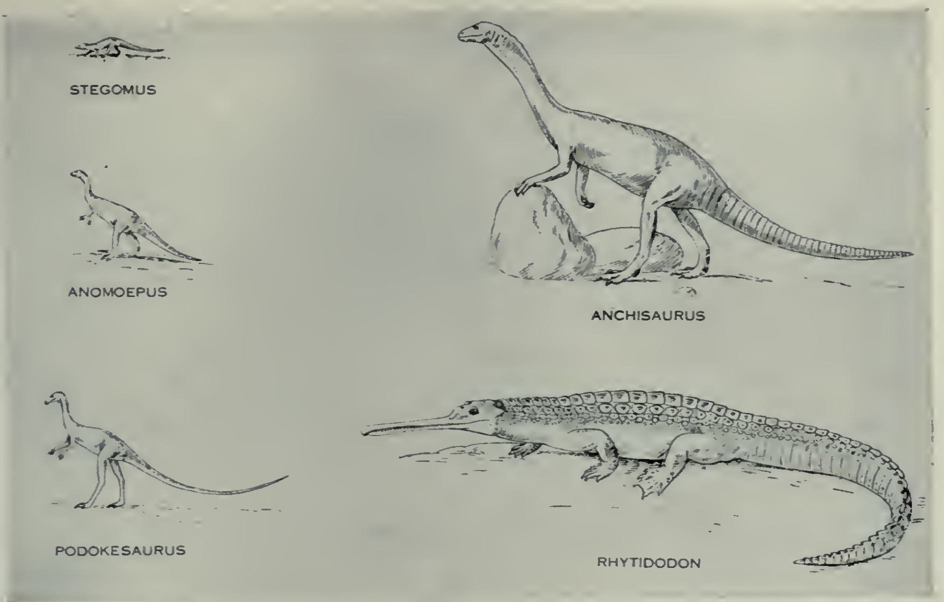
THE PROTEROZOIC ERA, IGNEOUS ROCKS: All igneous rocks of the crystalline area under consideration are younger than the sedimentary members since they have been intruded. But they are not all of the same age or kind. There are granitic stringers and sills which may date back to the close of the earliest of these sedimentary periods, since they partake of all the metamorphic changes that characterize these ancient strata including recrystallization and flowage. The most striking examples are the Yonkers granite gneiss, a sill, and the Ravenswood granodiorite, a boss. Some of the pegmatite streaks and basic intrusions belong to a period of more extensive metamorphic activity and penetrate the Inwood dolomite and Manhattan schist. Examples are the Harrison diorite, basic dikes, granitic dikes, bosses, and intrusions as shown on the accompanying geologic map, pp. 436-437. Serpentine, which is a metamorphic alteration product, has a like origin and distribution.

The entire basal series of rocks have been folded, crumpled, faulted, crushed, injected, intruded, and intensely modified by recrystallization, nevertheless, they retain the fundamental association and essential character of an originally sedimentary series. Many of the gneisses, a few of the schists, all of the granites



Slab showing passage of two Triassic dinosaurs after a shower. The raindrop impressions are represented by small pits. After R. S. Lull

Impressions of the feet and tail of a Triassic dinosaur on a ripple-marked surface. Specimen from Pleasantdale, New Jersey



Certain types of dinosaurs of Triassic age which inhabited the New York, Virginia, and Connecticut valley basins

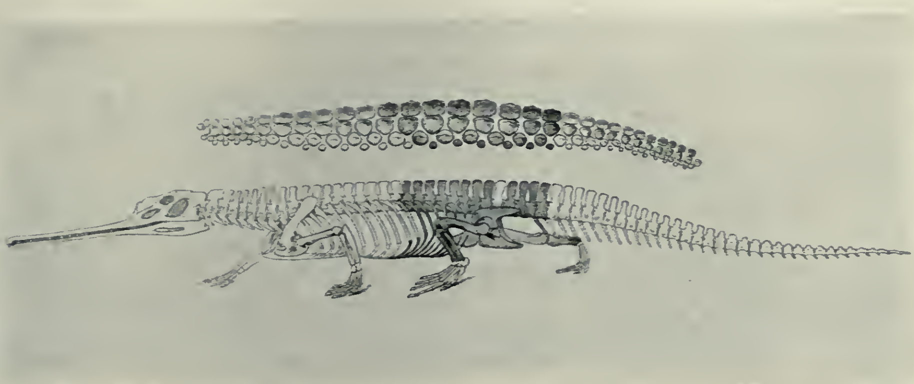
and diorites are of igneous origin and occur as sills, dikes, or bosses, cutting the metamorphosed sedimentary members. They, too, have been greatly metamorphosed and are very ancient, perhaps late Archæozoic or Proterozoic.

THE PALÆOZOIC ERA: The Palæozoic rocks and fossils, which represent a tremendously long period of time and follow the Proterozoic Era, are not found in the immediate vicinity of New York City. They appear, however, in great force in western New Jersey, New York, Pennsylvania, and the Mississippi valley states.

THE MESOZOIC ERA, TRIASSIC PERIOD: From the Hudson River westward to the crystalline rocks of the New Jersey highlands occur a thick series of reddish brown sandstones, shales, and conglomerates, called the Newark group, which dip 10 to 15 degrees to the northwest. Near Philadelphia, Trenton, and New Brunswick, the Stockton, Locatong, and Brunswick formations have been differentiated, but not beneath the glacial drift cover to the northeastward. These sedimentary rocks were deposited in a trough or graben with faulted margins which extended southwestward from the Hudson River across central New Jersey, Pennsylvania, and Maryland into southern Virginia. In all probability a major stream with lateral tributaries occupied the depression. The region was presumably high and arid. Ripple marks, mud cracks, rain drop impressions, and footprints of reptiles are common, especially in the Brunswick shale, and indicate flood plain and shallow water deposition. Restorations of the dinosaurs, *Stegomus*, *Anomoepus*, *Podokesaurus*, *Anchisaurus*, and *Rutiodon* (*Rhytidodon*), which inhabited this zone and the Connecticut Valley, are shown in accompanying illustrations, pp. 441-42-43. Only one skeleton, the Fort Lee *Rutiodon*, pp. 442-43, has been found near New York City. Fossil fishes and a small crustacean, *Estheria ovata*, have also been found. The fossil remains indicate Triassic age, the initial period of the Mesozoic Era, sometimes called the Age of Reptiles.

Three successive lava flows which were extruded during the deposition of the

Fort Lee phytosaur, *Rutiodon manhattanensis*. Photograph of the skeleton as preserved in the original matrix. About $^1/_{10}$ natural size. A description of it was published by the American Museum of Natural History, *Bulletin XXXII*, pp. 275-82, 1913



Restoration of the skeleton and dermal plates of *Rutiodon manhattanensis*. The shaded portion represents the parts preserved in the Fort Lee specimen. After R. S. Lull

Men excavating the skeleton of the Fort Lee phytosaur on the right bank of the Hudson River, opposite New York City. The specimen was found about twenty feet below the thick sheet of diabase of the Palisades in a red sandy marl

Newark beds have been subsequently faulted, flexed, and tilted into their present position. Since that event erosion has removed a great thickness of the sedimentary rocks and the upturned edges of the lava sheets are now exposed. The First and Second Watchung Mountains and Hook Mountain represent these three basaltic flows. The lowest, First Mountain, is about 600 feet thick, Second Mountain 800 feet, and Hook Mountain 300 feet. About 600 feet of red sandstone and shale separate the first and second, and 1500 feet the second and third. Red Triassic sandstone and shale are also found above and below these volcanic rocks.

The Palisade diabase is a great sheet of igneous rock, from 350 to 1000 feet thick, which was intruded among the lower strata of the Newark group. It extends from Staten Island northward along the west bank of the Hudson River to Haverstraw. At its southern exposed extremity it is practically at sea level, while at the north it is 700 feet higher. Throughout most of its extent it presents an escarpment of high cliffs with vertical columns of rock which were developed during the cooling stage and which suggest the name Palisades.

Cretaceous Period: Stratified rocks which represent the closing stage of the Age of Reptiles rest unconformably upon the Newark group in New Jersey and upon the crystalline basal complex in Staten Island and Long Island. Except for a few exposures along the north coast and the interior of Long Island the Cretaceous sediments are hidden by glacial deposits of Pleistocene age. Their presence, however, is ascertained from numerous deep-well records. In the unglaciated area south of Raritan Bay they are exposed over extensive areas. Here three well-defined members appear, the basal Raritan formation of plastic clays, the Mattawan formation of clay marls, and the Monmouth, including the Rancocas and Mansquan formations of green sand and marls. Fossil marine invertebrates and plant remains indicating Upper Cretaceous age are found in some of these beds. The Cretaceous deposits of Long Island, which average 1550 feet in thickness, vary greatly in composition within short distances and are, on the whole, more sandy than those of New Jersey. An exposure may be seen at Elm Point on Great Neck, Long Island.

The inclination to the southeast of the bed rock surface on which these sediments were deposited is about 40 feet to the mile in New Jersey, 80 feet near Oyster Bay and Huntington, and 40 feet at Port Jefferson, Long Island. The dip of the beds, which is the same as the slope of the unexposed floor, probably decreases toward the east and south. This old Cretaceous floor is still preserved inland in the crests of the Palisade and Watchung ridges, Schooley Mountain and Kittatinny Mountain of New Jersey and in the truncated folds of the Appalachian Mountains west of Harrisburg, Pennsylvania. Locally in Long Island the weak upper beds of the Cretaceous series have been greatly folded and contorted by the passage of the Pleistocene glaciers over them.

The Cenozoic Era, Pleistocene Events: Four glacial and three interglacial stages are represented on Long Island. The periods of glaciation correspond to the Nebraskan, Kansan, Illinoian, and Wisconsin of the Central United States, and to the Günz, Mindel, Riss, and Würm of the Alps Mountains. Locally they have been named by Mr. M. L. Fuller, of the United States Geological Survey, the Mannetto, Jameco, Manhasset, and Wisconsin stages and are represented primarily by gravel and morainal deposits. The only ones represented within the limits of the accompanying geological map are the Manhasset and Wisconsin. The outwash, terminal moraine, till, and retreatal outwash deposits of the Wisconsin stage are far more extensive and readily examined than the similar accumulations of the older stages since they were the last and cover in large part those made during the preceding glaciations.

The First Interglacial stage, the post-Mannetto, was long, for a great erosion unconformity exists. Following the deposition of the Mannetto gravel of the First Glaciation, there was a period of uplift and erosion in which the Mannetto was cut to a depth of 300 feet below sea level, as shown by the depth of the buried Jameco channel in Long Island. The great length of this period of erosion, indicated by the almost complete removal of the thick Mannetto gravel from the Long Island region, is in harmony with the time required for the cutting of the Hudson River rock gorge to a depth of 750 feet below present sea level. The gorge proper appears to be filled solely with Pleistocene materials as indicated by the Storm King and other borings; hence, its cutting is to be referred to a date later than the deposition of the latest Tertiary beds in New Jersey.

The narrow, steep-sided and deep outer cañon of the submarine channel, if due to stream erosion, must be referred to an elevation of great magnitude, 4800 feet, occurring at the close of the post-Mannetto erosion stage. The great drops or falls in its beds are characteristic of a juvenile stream or old one which has been rejuvenated. As only the edge of the continental shelf was notched, the epoch of maximum elevation must have been brief.

During the Second Interglacial stage, the Yarmouth of the Mississippi Valley, the Gardiners clay was deposited in Long Island. It was followed by a transitional epoch represented by the Jacob sand. Throughout the time of the Second Glaciation, the Second Interglacial, and the Third Glaciation, the channel of the Hudson remained constantly below sea level. The deposits, which have a combined thickness of about 500 feet, doubtless obliterated the upper reaches of the submarine Hudson channel.

The Third Interglacial interval, the Vineyard, is represented by (a) a great erosion unconformity, and (b) the Vineyard formation, consisting of marine deposits and peat. The valleys in the Manhasset deposits, although somewhat modified and partly filled with the later Wisconsin accumulations, are known to extend some distance below sea level at many points along the north shore, indicating a former higher position of the land. The present upper submarine channel of the Hudson, which has a depth at its outer end of 350 feet, suggests that the land must have been elevated to that extent during the Vineyard interval.

There are no erosion channels referable to Wisconsin or post-Wisconsin elevation on Long Island. The upper end of the Hudson channel, however, between Sandy Hook and Rockaway Beach, has been obliterated in part by Wisconsin outwash and in part by the shifting of the sands by the littoral currents that now sweep along the coast.

Thus in this rapid survey we have considered very briefly the Archæozoic, Proterozoic, Palæozoic, Mesozoic, (Triassic, Cretaceous), and Cenozoic (Pleistocene) series of rocks as represented in New York City and its vicinity. They are replete with interest but they represent only a few isolated and incomplete chapters of the geologic history of North America. The long Palæozoic era, including the Age of Invertebrates, Age of Fishes, and Age of Amphibians, is not represented by sediments in the area of the geologic map, pp. 436-37. The Jurassic and Lower Cretaceous periods occupying the middle portion of the Mesozoic era, the Age of Reptiles, are also not represented in this district. Likewise the Tertiary series, corresponding to the Age of Mammals, appears outside the area. The Pleistocene glacial deposits, which are contemporaneous with the Age of Man, are rather fully represented but, as yet, no human remains have been found in them in this area or anywhere in North America.

GENERAL VIEW OF MORGAN MEMORIAL HALL

The specimens receive emphasis by contrast with their unobtrusive surroundings, the subdued tone of the cases and backgrounds merging into that of the walls and ceiling

THE MORGAN MEMORIAL HALL OF MINERALS AND GEMS

BY

HERBERT P. WHITLOCK*

WITH the completion of the Morgan Memorial Hall of Minerals, the construction of which was made possible through the generosity of Mr. George F. Baker,[1] the American Museum of Natural History has been enabled to place before the public, in surroundings and under conditions of display commensurable with their importance, the finest collection of minerals and gems to be found in America.

Because both in conception and details the presentation of these two great collections involves, from a museum point of view, the working out of several unique ideas, it may be well to describe briefly the present installation and to point out in what respects it differs from that of a year ago. In thus contrasting the new with the old we are faced at the outset with two very significant paradoxes. Regarding the disposition of the collections, the Morgan Memorial Hall now contains the mineral collection, which still occupies the same space as formerly (the southwest wing on the fourth floor), and the gem collection, hitherto on exhibit in the west corridor. Despite this consolidation, the present installation gives the impression of more free space than was conveyed by either of the former installations. This result was achieved by the judicious introduction of vertical methods of casing in both sections of the installation. In respect to the lighting, although the lower portions of the windows on the south side have been closed to accommodate vertical wall cases, the hall is very much better lighted than it was formerly. This is due to the introduction of ground glass in the north windows and in the upper portions of the south windows, the diffused light thus obtained, together with the light reflected from the vaulted ceiling, giving an illumination which is both ample and restful.

In the general scheme of display the specimens have been emphasized by a consistent adherence to the principle of subordinating their surroundings. For instance, if the case containing a specimen, and the shelf, bracket, or mount that supports that specimen are brought unduly into prominence, they will detract from its effective presentation. The cases, backgrounds, and mounts have, therefore, been tinted to harmonize with and merge into the color of the walls and ceiling. That such an innovation in museum display methods accomplishes the result of effectively presenting the specimens to the eye, seems amply proved in the case of the present installation, where, especially in the vertical wall panels, the specimens are individualized with striking effect.

The twenty-eight vertical panels of the cases which extend along the east, south, and west walls of the hall have been planned with three distinct purposes in view: the creation of an effective and decorative motive of wall display; the assembling of the most highly attractive pieces of the collection into a relatively small and easily viewed series, calculated to interest the casual and uninstructed visitor; and the disposal of the large specimens, which could not be conveniently displayed in the flat cases of the main installation, in reasonably close proximity to their appropriate positions in the latter arrangement. The second of these three functions is the one which has been especially developed and emphasized, the wall panels constituting, as it were, an introductory collection

[1]For an account of Mr. Baker's valued gift, made in memory of his friend, the late John Pierpont Morgan, the reader is referred to NATURAL HISTORY, March–April, 1922, p. 180.

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A WALL DISPLAY OF MINERALS

Twenty-eight vertical panels are arranged in the cases along the walls. The interest of the visitor is aroused by the striking exhibits displayed on these panels, while in near-by cases are hundreds of related specimens offering opportunities for more extensive study

GEM STONES SEEN TO BEST ADVANTAGE

The new and unique method of showing the gem stones on inconspicuous glass supports carries out the basic idea of subordinating the surroundings of the specimens. An example of the old style of mounting on wire supports is shown for comparison in the case of a specimen in the upper left corner

UNCUT GEM MATERIAL AND FINISHED JEWEL

In the cases of the gem collection the relation between the minerals and the gem stones cut from them is emphasized by the exhibit of uncut gem material in the upper section of the cases and the display of the cut gems in the table section

from which the visitor may glean the essential significance of the entire exhibit. To this end much thought has been given to the composition of the panel labels, which not only explain the contents of their respective panels but, taken in series, furnish a brief and concise statement of the principles of mineral formation. Beginning with the native elements, representing the essence of simplicity in the composition of minerals, one is led by almost insensible gradations to the more complex combinations of elements. Each panel grouping of specimens thus illustrates, as it were, a text which, taken by itself, conveys an important truth, and, considered together, the whole series furnishes a key to the entire contents of the hall.

In thus arousing the interest in what we may call the *key exhibit*, attention is directed to the vast resources of the main installation disposed in adjoining cases, the position of which is indicated at the bottom of the panel labels. In this way the visitor whose interest has been stimulated in some section or phase of the key exhibit is led to the part of the installation where examples of what he seeks are multiplied in great variety.

In the installation of the principal mineral collection, much space has been gained and the general appearance of the exhibit has been greatly improved by introducing alongside each of the twelve piers which support the vaulted ceiling high, free-standing cases with inclined shelves. This arrangement breaks the monotony of a continuous succession of flat glass lids, such as in the previous disposition of the cases presented to the eye literally a "sea of glass."

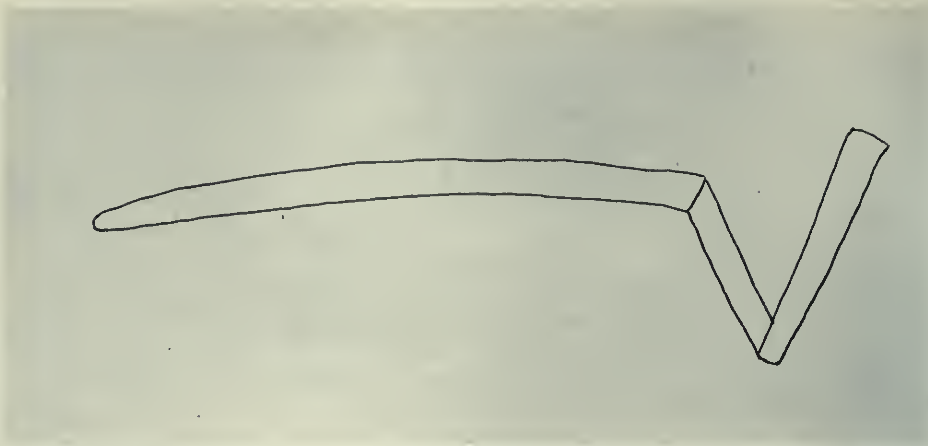
In abandoning the former hall of gems and placing the gem collection in Morgan Memorial Hall, two distinct objects were accomplished. Thus was gained for the gem collection the advantage of far better natural lighting and the no less great advantage of close juxtaposition to the mineral collection with which it is of necessity affiliated as a natural adjunct. The present series of gem cases are arranged in double units along the axis of the hall, in this way profiting by light from both north and south windows. The vertical section of each unit is used in general to display the raw gem material of the mineral illustrated, and the flat section is reserved for the cut, engraved, or carved stones.

As in the instance of the vertical wall panels, the explanatory labels attached to the gem cases are made an important feature. Here, however, the text of each label is somewhat more extended to meet the need of the average visitor for information regarding objects about which his interest has already been aroused. Following the same line of presentation, the subject matter of the label is somewhat more detailed and the facts are presented with less breadth of treatment.

A notable feature of this installation is the use of a new type of gem mount for displaying cut stones. The gems are supported each on a structure of thin glass rods which is practically invisible except at close range, and displays the specimen against its background without the interference of the shadow which would be always present were the gem in contact with that background. In this way the color by transmitted light is shown to best advantage and without the appearance of opaque support so characteristic of wire mounts.

In some instances a diaphragm background is introduced, as in the cases containing the series illustrating the antique and prehistoric uses of gems, where strings of antique beads are shown to advantage against a vertical background.

Throughout the installation care has been taken to display individual specimens to the best advantage, emphasizing the large and fine pieces and contrasting by juxtaposition slight differences of color. Where several small stones are available, these have been grouped in circles, festoons, pendants, and other jewelry groupings, to conform to slight differences in size and style of cutting. In this way certain features of the gem collection which are of interest to the jeweler are emphasized, and the collection acquires an educational value in this little-known field of the many-sided science of mineralogy.



Diagrammatic figure of a backbone of some unknown fish, found by Dr. E. W. Gudger, embedded in the mesentery of a barracuda at Tortugas, Florida

FOREIGN BODIES FOUND EMBEDDED IN THE TISSUES OF FISHES

BY

E. W. GUDGER*

THAT the larger fishes, especially the sharks, do not discriminate in regard to the things they swallow, is known to all students of ichthyology and is not wholly unknown to the general public. From my own dissections of sharks I have made a list of all sorts of incongruous materials found in their stomachs: heads and horns, hoofs with iron shoes, bones of all kinds, the skeletons of birds and their feathers, the beaks of turtles and their scutes, tin cans, and a host of other preposterously indigestible things. Furthermore, to my own list I have added data from various other writers until the list is almost as large as it is varied and incongruous. But to the average student of fishes, as well as to the readers of NATURAL HISTORY, I suspect that the title of my article will seem strange and unusual.

Many years ago, while dissecting a fish in the laboratory of the United States Bureau of Fisheries at Beaufort, North Carolina, I found embedded in a fold of the mesentery a hard, fairly straight body from five to seven inches in length and with approximately the diameter of a small lead pencil. On cutting it out and carefully freeing it from the enveloping tissues, I found it was a mummified pipefish, which had been swallowed at some previous time, had worked its way out into the mesentery and had there become preserved. The pipefish was very much shrunken, consisting of hardly more than the bony framework and the tough integument, and was very hard, offering considerable resistance to the scalpel; but there was no evidence that putrefaction had taken place, nor had the containing fish suffered any apparent injury. My notes made on the occasion having been destroyed and the mummy lost, further information unfortunately cannot be given.

In July, 1912, while dissecting a barracuda (*Sphyræna barracuda*) at the Marine Biological Laboratory of the Carnegie Institution of Washington, which is located at Tortugas, Florida, I found a similar body embedded in the mesentery. Recalling my past experience, I at once suspected that this also was a pipefish, but when it had been freed from the mesentery, it proved to be merely the backbone of some unidentifiable fish. It was about five inches long

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and fairly straight save at the upper end, where it was bent in the fashion shown in the figure on page 452. This phenomenon was reported and the figure published in my paper on the barracuda.[1] How the pipefish referred to in the previous paragraph could have worked its way through the intestinal wall into the body cavity can at least be conjectured, but how this vertebral column could have done so is hard to conceive.

Becoming interested in this phenomenon and being informed that the late Vinal Edwards, the veteran collector at the station of the United States Bureau of Fisheries at Woods Hole, Massachusetts, had noted similar occurrences, I wrote to him for additional data. Under date of February 3, 1917, he answered that since 1908 he had noted three such occurrences; namely, in a hake, a swordfish, and in a sculpin. In the first two there was "a skeleton of a fish in the meat near the backbone." In the case of the hake the embedded skeleton was about ten inches long and in that of the swordfish about a foot long. In the sculpin he found what looked like a pipefish. These were all sent to the Bureau of Fisheries in Washington, but as the war was at the time engrossing men's energies, the specimens were mislaid and cannot now be found.

Bearing these things in mind, when I became joint editor with Dr. Bashford Dean, of the *Bibliography of Fishes*, which is being issued by the American Museum, I noted down all similar occurrences in the course of our indexing the vast literature on fishes brought together in this work. The data thus gathered are added herewith to that presented above, in the belief that the readers of NATURAL HISTORY will find them of interest and possibly of value.

The first of these accounts is that given by Captain N. E. Atwood[2] before the Boston Society of Natural History, April 1, 1857. He is quoted as saying that:

"The cod often swallows alive the tant or sand-eel and the pipe-fish, both having heads very much elongated anteriorly and pointed. These fish sometimes pierce the stomach of the cod and escape into the abdominal cavity, and there they are found in a perfect state of preservation. adherent to its walls, but changed in color to a dark red, and in substance so hard that they are not readily divided with a knife. They have to be cut away before the cod can be split open. The fish is always in good health apparently, and there are no marks of inflammation about the stomach or abdominal cavity, unless the material of attachment be considered as such."

The next account was also given by Captain Atwood[3] before the Boston Society of Natural History on January 5, 1859, and is thus reported in the *Proceedings* of that society:

"Fish are often swallowed by the cod, pass from their stomach into the abdominal cavity, and are there found mummified and adherent to the inner walls; he presented a specimen, apparently of the eel family, thus preserved and hardened, which he had taken from the abdominal cavity of a pollock. . . . He presented two large cod hooks, with portions of the line attached, which he had taken from the livers of apparently healthy cod; the greater part of the hooks was buried in the organ, and must have remained there, he thought, at least twelve months; they must have been swallowed, broken off, and have worked their way through the stomach into the liver."

Nine years later (1868) Captain Atwood[4] again addressed the Boston Society of Natural History on this subject. The report, as recorded by the secretary, reads as follows:

"Captain Nathaniel E. Atwood exhibited a codfish which presented a curious appearance. A number of sand-eels were seen in the walls of the abdominal cavity; they were so hard as to resist the knife, not at all decomposed, and in many places with a sort of earthy crust or membrane of their own. Capt. Atwood said the occurrence was not an unusual one, and the cod, being in good condition, had apparently not suffered at all by this phenomenon."

Thereupon the presiding officer, Dr. Jeffreys Wyman,[5] remarked that there were three fairly well defined features presented by this fish. In the first place, the eels were outside the cavity of

[1]Gudger, E. W. "*Sphyræna barracuda:* its morphology, habits, and history." Publication No. 252, Carnegie Institution of Washington [D. C.], 1918, p. 72, text-fig. 5.

[2]Atwood, N. E. [Notes on the habits of some marine fishes]. *Proceedings*, Boston Society of Natural History for 1856–59, Vol. 6, p. 176.

[3]Atwood, N. E. [Foreign bodies found in the body cavity or in the liver of the codfish]. *Proceedings* Boston Society of Natural History for 1859–61, 1861, Vol. 7, p. 4.

[4]Atwood, N. E. [Exhibition of and remarks upon a codfish which had a number of sand eels in the walls of the abdominal cavity.] *Proceedings* Boston Society Natural History for 1866–68, 1868, Vol. 11, p. 364.

[5]Wyman, Jeffreys, [On the occurrence of sand eels in the abdominal cavity of the cod]. *Proceedings*, Boston Society of Natural History, for 1866–68, 1868, Vol. 11, p. 364.

Of all the strange objects found embedded in the tissues of fishes, none will perhaps excite greater wonder than the curiously shaped knife, with handle of brass, here reproduced in its natural size. The cod that swallowed this knife at least had the discretion to do so when the blade was closed, for the knife was shut when found. After Collins

the stomach; in the second place, they had an investing membrane of their own although they had apparently been embedded in the cod for some time, and finally—the most remarkable point of all—they showed no signs whatever of putrefaction. The fact that they had not decomposed he thought, on the theory of Pasteur, was due to the absence of any disturbing agency.

Apropos of the strange things swallowed by fishes and in anticipation of the embedded foreign body next to be noted, attention is here called to a letter from Capt. J. W. Collins to Prof. S. F. Baird, published in the United States Fish Commission *Bulletin* for 1884, p. 175. In this Captain Collins puts on record the finding in the stomach of a large codfish taken on Le Have Bank, of a knife known as a "haddock ripper."

However, in 1886, Captain Collins[1] recorded what is undoubtedly the most remarkable instance known of a foreign body embedded in the flesh of a fish. We will let him tell his story in his own words:

"While discharging a fare of codfish from the schooner Vinnie M. Getchell, at Gloucester, Mass., on September 15, 1885, Capt. John Q. Getchell, master of the vessel, found embedded in the thick flesh of a large cod a knife of curious workmanship, represented by the accompanying illustration, which is of full or natural size.

"The fish in which the knife was found was one of a fare caught in 75 fathoms of water on the northeast part of George's Bank; it was apparently healthy, being thick and 'well-fed,' and, according to Captain Getchell, would weigh about 40 pounds after being split, or say 60 pounds as it came from the water. The general excellent quality of the fare of fish attracted considerable attention from people who saw them, and led to the discovery of the knife. Some remarks having been made concerning the fish, Captain Getchell lifted several of them from a tub (where they had been thrown to wash after being weighed) and exhibited them to the by-standers, commenting on the size and thickness of the specimens. Holding one across the edge of the tub in a semi-curved position, he ran his hand over the thicker portion of the fish to call attention to its fatness. In doing so, he felt something hard beneath his fingers, and further examination produced the knife. Of course much surprise was expressed by those present who had never before seen such a strangely formed implement, and speculation was rife as to how it came there. When found, the knife-

[1]Collins, J. W. "A curious knife found in the flesh of a codfish." *Bulletin,* United States Fish Commission for 1886, 1887, Vol. 6, pp. 381–83, figure.

blade was closed, and the small or posterior end of the handle was the part first felt by Captain Getchell, and was nearest the tail of the fish.

"The flesh of the fish where the knife was imbedded is estimated to have been $2\frac{1}{2}$ inches thick. Unfortunately, the excitement attending the finding of the knife prevented any notice being taken of the fish, which was carried off and salted among the others; therefore nothing is known as to whether the implement was encysted or not.

"The handle of the knife is of brass, curved and tapering posteriorly, with a longitudinal incision, on the concave side, to receive the edge of the blade. The handle is remarkable in form, and is suggestive of the handiwork of some savage tribe or the scrimshaw work of a sailor. Its length, measured with the curve, is $3\frac{5}{8}$ inches, and its greatest diameter one-half inch.

"The blade is lanceolate in form, with the cutting edge curved outward, to fit into the handle, and the back nearly straight. It has been corroded a good deal and the extreme point is very thin. Its length, from handle to tip, is $2\frac{3}{4}$ inches; greatest thickness (near the handle), one-eighteenth inch; and its greatest breadth a little less than one-half inch. The total length, from point to point in a straight line, is $6\frac{1}{4}$ inches.

"How did the knife get there? is the question that will be asked by those who are not too skeptical to credit the story of its being found as has just been stated. Personally, I neither doubt the finding of the knife, nor the probability of its being found as stated. It is a fairly common occurrence for fishermen to find the sand-launce, or lant, imbedded in the flesh or the liver of the cod, and dried very hard. I have many times see lant thus imbedded, and in no case that I remember was the cod any the worse for it. It is therefore evident that it is possible for the stomach of a cod to be penetrated by a sharp-nosed fish or by an implement it has swallowed, and ultimately for either to work its way through and become imbedded in the flesh, while the wound heals and the stomach goes on to perform its ordinary functions.

"As to where the fish got the knife we can only conjecture, unless some ethnologist can point out its origin. In any case, the finding of such a remarkable implement in such a strange place must be a matter of interest to the ethnologist and naturalist alike."

However, let us return to our sand eels, since they seem to be the *pièce de résistance* of the cod family. In 1885 W. H. Barrett[1] mentions the finding of a sand eel embedded in the liver of a haddock. It was four inches long and was firmly embedded, with its dorsal region toward the liver. The head and half an inch of the body lay in a groove formed by pressure in but were non-adherent to the liver. The other parts of the eel were, however, adherent to it. The little fish was partly covered over with white membrane, which in spots was apparently filled with cohesive matter. Because of this it was difficult to cut through the fish with a knife.

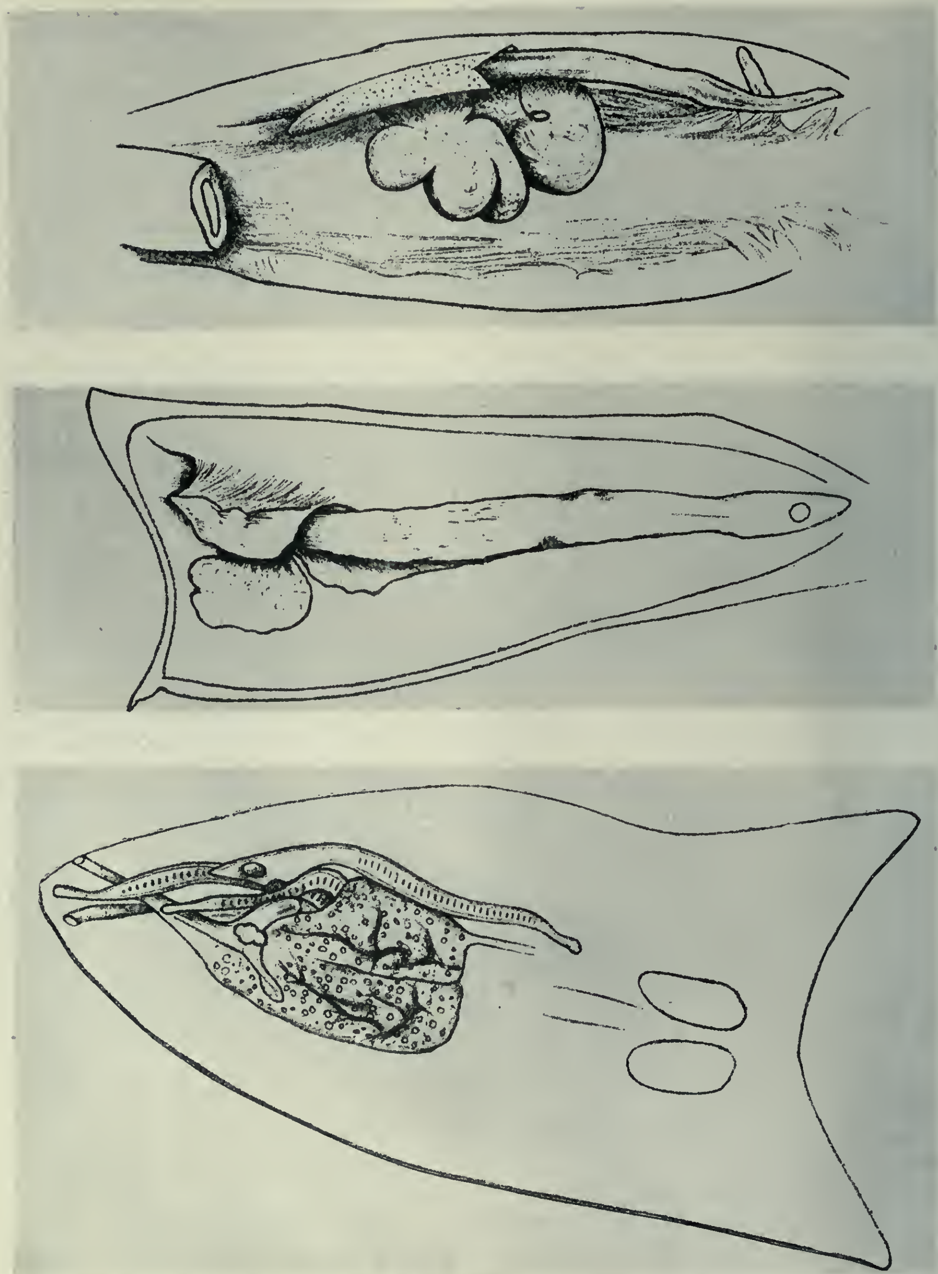
Barrett explains the penetration into the body cavity as follows. He notes that the sand eel penetrates the sand by using its sharp-pointed lower jaw as a wedge or drill. He thinks that the fish is swallowed head first and that head first it penetrates into one of the cæcal diverticula just below the stomach. It then bores with its jaw until its head penetrates into the body cavity, but if the cæcum is too small to let the larger shoulder region pass through, the fish is caught and held. However, the fish by vigorous wrigglings may tear the cæcum off and pass out into the body cavity of its host, where it would die surrounded by its cuirass of cæcum. Later, partly through pressure and partly as a result of inflammatory processes, it would become embedded in and adherent to the liver.

The most extensive series of observations of the phenomenon ever made, illustrated by the only figures known (save that of the knife and my own of the backbone) we owe to H. C. Williamson,[2] who published so lately as 1911. According to his records, also, sand eels were the chief offenders and the number of instances of their penetrating into the body cavity of their devourers was eight in all. Speaking of these cases in general, he says:

"The sand-eels, after being swallowed by the fish, have escaped from the gut and passed into the abdominal cavity. There they have generally damaged the liver before they died. Sometimes they are found with the head or tail jammed tightly into the space between the reproductive organ and the peritoneum. They are covered with a material which resembles a hardened paste, and in some cases they are in part enclosed in a skin of connective tissue derived from the peritoneum. In this way they are reduced to a mummified condition. . . . One large sand-eel was commonly found in the

[1] Barrett, W. H. "Note on the liver of a haddock in which a sand-eel was partly embedded." *Third Annual Report, Fishery Board for Scotland*, for 1884, 1885, Appendix F, No. V, pp. 70–2. 3 figs.

[2] Williamson, H. C. "Sand-eels (*Ammodytes sp.*) and a Hermit-Crab (*Eupagurus bernhardus*) encysted in the abdominal cavity of the Haddock (*Gadus æglefinus*), Cod (*Gadus callarias*), and saithe (*Gadus firens*)." *28th Annual Report*, Fishery Board for Scotland, Part III—Scientific Investigations—1911, pp. 62–3. 6 figures.



SANDS EELS EMBEDDED IN THEIR DEVOURERS

It sometimes happens that, in defiance of the laws of digestion, an object swallowed by a fish, instead of passing through the alimentary canal, will work its way into the abdominal cavity, remaining there permanently, without undergoing decay itself and without necessarily causing vital injury to the fish. Among the objects swallowed as food that are most apt to behave in this perverse fashion are sand eels. In the upper and middle pictures are seen the long, thin bodies of two of these eels attached respectively to internal organs of the cod and of the haddock. The lowest picture reveals no less than three sand eels assembled in the abdominal cavity of a haddock. After Williamson cavity, but in one case three small sand-eels were present."

Some of Williamson's clearer figures are reproduced herewith, together with the gist of his remarks concerning each case. Three cases are not figured, but of them he says:

"A large sand-eel, 7¾ inches in length, was lying along the dorsal region of the abdominal cavity of a codling. It was thickly plastered with hardened paste. Its tail was twisted round the urinary bladder. The skin of the liver, which had evidently been destroyed, was attached to the peritoneum as a thickened wall along the ventral part of the abdomen.

"Another codling had a very small sand-eel, 2⅜ inches long, coiled up at the anterior end of the abdominal cavity. The anterior third of the fish was buried in the liver, and the liver had grown attached to the peritoneum. A sand-eel was discovered in one saithe. It was adhering to the abdominal wall."

Now we come to the last, and, taking all things into consideration, the most remarkable case of an embedded body ever recorded. Those previously described, including the knife, are pointed bodies, which one might expect would under favorable conditions penetrate the walls of the stomach or of the intestine and pass into the abdominal cavity. But the intrusive animal to which attention is now called is bulky and, furthermore, is provided with five pairs of sharp-pointed legs that are capable of offering opposition. The case in point is that of a hermit crab, which, probably finding that it had outgrown its quarters in some marine snail shell, had left its safe home to seek new quarters, and while on this unprotected quest had been spied by a wandering codfish, pounced upon, and swallowed whole. However, it revenged itself in true melodramatic fashion by penetrating the wall of the stomach and passing into the body cavity where it became transformed into a mummy, surely to the great discomfort of its former captor and present host.

Williamson agrees with Barrett that the sand eel might without great difficulty penetrate the walls of the stomach, cæcum, or intestine, and thus get into the cavity of the abdomen, but that this could not have been the process by which the crab passed, he is sure. The crab, he thinks, must have passed through the wall of the stomach at a point where the tissue was weakened, possibly to some degree by the attacks of some intestinal parasite, such parasites being found only too frequently in fishes.

Some occurrences of intrusive bodies, such as those of pipefish and sand eels, in the body cavity are fairly easily explained, and even the presence of the hermit crab can be understood. Not so clear, however, is the presence of the spinal column which I found in the abdominal cavity of the barracuda; and I am entirely at a loss to explain how the knife made its entry and how the skeletons noted by Vinal Edwards could have penetrated into the great muscle of the back of the fishes in which they were found. Careful dissections of such specimens by a trained anatomist might show traces of the manner of penetration. Until such an opportunity offers itself, the matter must remain more or less of a mystery.

A hermit crab adhering to the internal surface of the abdominal wall of a cod. How this crustacean, with its stretch of three inches, and its sharp-pointed legs and ponderous claws, was able to make its way into the body cavity is as hard to explain as the fact that a fish subjected to such rough treatment internally should have escaped mortal injury. After Williamson

A fossil stump of *Psaronius* recently presented to the American Museum by the New York City Board of Water Supply. *Psaronius* is among the oldest "trees" of which we have evidence, antedating by millions of years the appearance on this earth of the plants of the Coal Period, the great reptiles, and the early mammals, which are so vastly remote when viewed from the standpoint of human experience of time

A TREE FERN OF MIDDLE DEVONIAN TIME

BY

EDMUND OTIS HOVEY*

PLANT life of some kind must have flourished on the continents and islands of very early geological time, but the plants themselves did not contain woody tissue enough for preservation in the fossil state, nor were other conditions favorable for such preservation. It is not until the Hamilton Period of Middle Devonian time that evidences of land vegetation become abundant, and even then the verdure which, it may be assumed, covered the hillsides, disappeared entirely when it died. Lycopods, ferns,

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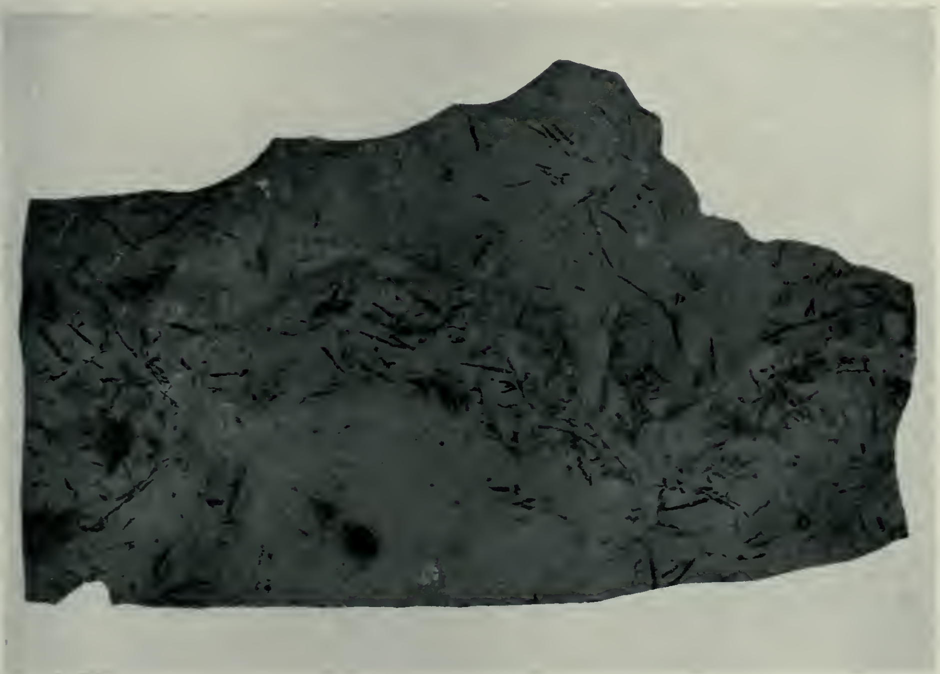
horsetails, or scouring rushes, and the like—plants which love the damp spots of the land—are the only forms which the luxuriance of the old tropical or subtropical forest. Flowers were absent, but the foliage must have been beautiful.



The American Museum is indebted also to the New York City Board of Water Supply for several sizable fragments of rock on which the leaves of the tree fern *Psaronius* left their fossil record to be read and interpreted æons later by man. One of these slabs of rock, with the ribbon-like leaves broadly distributed over its surface, is reproduced herewith

have been fossilized, with the result that their remains have come down to us.

The oldest "trees" known in the world are, accordingly, the gigantic tree ferns of the Hamilton Period of Middle Devonian time. They flourished in the swamps of the regions now known as central New York State and Ohio, as well as elsewhere, and they grew to enormous size, trunks four feet in diameter having been found. The eminent Canadian geologist, Sir J. William Dawson, devoted much study to these forms of plant life, and he gave them the name *Psaronius Erianus*.

In those days of long ago the climate of central New York must have been warmer and more moist than it is at present, and we may picture to ourselves The leaves of *Psaronius* were, apparently, ribbon-like in character and rose in a graceful tuft from the short stump. There was no high bole to the tree and it had no branches.

One of the features of the comprehensive plan for using the water resources of the Catskills to furnish an adequate supply of good water to the city of New York is the diversion of the upper portion of Schoharie Creek into the Ashokan Reservoir. In carrying out this project the engineers of the New York City Board of Water Supply are constructing a massive concrete and masonry dam at the little village of Gilboa, Schoharie County, and to secure stone for facing have opened a quarry in the Hamilton sandstone down stream from the site of the dam. In this quarry they have come upon a bed sixty feet below the horizon at which the original Gilboa tree stumps were found, and in this bed they discovered several perfect and nearly perfect stumps of tree ferns resting upon a bed of shale marking the level of the ancient swamp. From this series a stump thirty-two inches in diameter and about two feet high was selected and presented to the American Museum by the New York City Board of Water Supply. This beautiful stump and some of the ribbon-like leaves from the associated sandstone have been installed in the Devonian case in the hall of geology and invertebrate palæontology on the fourth floor of the Museum.

Photograph by E. O. Hovey

Quarry in the Hamilton Sandstone at Gilboa, New York. The stumps of the giant tree fern *Psaronius* were found upon a thin bed of shale exposed at the bottom of the quarry face

A COLLEGE COURSE IN ZOÖLOGY*

BY

HAROLD H. PLOUGH[1]

THE profound effect which the development of modern biology has had both in the field of ideas, and in medicine and public health, has resulted in widespread recognition of the fact that an acquaintance with this science in its broad outlines has an essential place in any scheme of liberal education. In many institutions it is the first course in zoölogy which has been called on to supply this general knowledge. The greatly increased enrollment in such a course—an enrollment which in certain of our larger universities has passed the five hundred mark—is clear evidence that the subject is making a wider appeal. Such a course is no longer primarily an introductory course for students who are beginning their training in some special field. It is rather a cultural course for those who have no thought of specializing, but who wish to understand something of the results of biological research because of their intrinsic importance and their relation to the broader problems of human living. This gradual change in purpose has made the first course in zoölogy very much more interesting and suggestive to the layman with little knowledge of natural history than it was formerly. The emphasis has come to be placed on the broad principles which biological research has established or is opening up, and less on the practical training designed as a foundation for the special student of biology. It is probable that such a course, even though it may sacrifice much necessary detail, will prove in the end to have been the better approach to the subject not only in the case of the general but also of the special student.

Within the last year or two much discussion has arisen among college teachers and other professional biological workers as to the best method of presenting the newer type of general course. The older course, standardized by Huxley and still the basis of most of our zoölogical textbooks, was mainly morphological. It carried the student through a more or less detailed laboratory study of a typical specimen of each of the important groups of animals, with some incidental discussion of their evolutionary connections and their relation to man. As a result of the trend now in progress, the opposite extreme has been reached in the course outlined in the textbook entitled *Principles of Animal Biology* by Professor A. F. Shull, of the University of Michigan (McGraw-Hill Book Company, New York City). The course outlined completely abandons the older method and arranges its facts about certain rather artificial subdivisions of the subject similar to those groups in which the various research workers in the biological field find themselves aligned. Thus we have sections devoted to morphology, physiology, embryology, geographical distribution, taxonomy, etc. This method of treatment by no means abandons the first-hand laboratory study which is perhaps the most important and distinctive feature of any elementary course in science. It merely groups laboratory dissections and experiments so that they bear strictly on the principles under discussion. As given by Professor Shull, with the collaboration of other members of the department at Michigan, the method is found to be successful in attaining the objects already stated.

To many teachers, however, this development appears to have overshot the mark. After all, the basic facts of biol-

*A review of *Zoölogy—A Textbook for Colleges and Universities*, by T. D. A. Cockerell, Professor of Zoölogy, University of Colorado.

[1]Associate Professor of Biology, Amherst College.

ogy are morphological, or at least deal with the interaction of form and function. Embryologist, physiologist, geneticist, and student of evolution, are investigating different sets of facts relative to the complete animal, and without a knowledge of animal structure the significance of their work is lost. In attempting to satisfy the increased emphasis on the broad principles of the science, there is danger of obscuring the root of the principles themselves. No discussion of biological conclusions can be of great value to a student unless he has a certain minimum of knowledge of the morphology of representative animals. For some such reasons teachers more commonly retain the elements of the older method while completely shifting the emphasis—that is, a certain number of animal types are investigated in some detail, and with this knowledge as a foundation discussions and experiments are added which bring out clearly the broader conclusions deduced from modern research.

For such a course a textbook is not an essential requirement. Huxley always advised elementary students not to use one, but to get their knowledge from their own observation in the laboratory and the supplementary description and discussion given by the teacher. While this is certainly sound with respect to the individual work in the laboratory, there are few students who are not aided by a concise running account of the principles under discussion. It is true also that few instructors find it possible to give adequate emphasis to all lines of biological investigation. These deficiencies a textbook can supply. It should not be a substitute for the teacher nor for the observations of the individual student. It can supplement both by giving added unity and interest.

A new textbook which has such a purpose in view, and which meets the newer point of view of the general course is *Zoölogy* by Professor T. D. A. Cockerell, of the University of Colorado (World Book Company, Chicago and Yonkers, N. Y.). Professor Cockerell has carried on productive research in many biological fields, and that fact gives him peculiar fitness for the task of preparing a textbook of this kind. His book follows the standard treatment to the extent of giving a brief account of the successive groups of animals, but it omits the usual detailed anatomical descriptions, thus placing the responsibility for careful laboratory observation of structural details entirely on the student. The theoretical chapters dealing with established biological principles and the results of current research on important problems are scattered throughout the book. These discussions are for the most part complete in themselves, so that teachers who vary the order may do so without causing difficulties in the context. A valuable innovation is the addition at intervals of short, interesting biographical chapters describing the life and work of a number of world-famous biologists, as well as one or two who, like Agassiz, were noted mainly for their part in establishing the science in America. The book has now been out for over a year, and promises a considerable term of usefulness in colleges and universities. For many who are not students, it may prove of value as a readable and accurate summary of the more important facts which make up modern zoölogy.

The first quarter of the book is general in character. The fundamental characteristics of all organisms are discussed in short chapters dealing with the cell and its activities, tissue structure, and cell physiology. The subject of heredity is then introduced with an account of the life of Mendel and a statement of the laws of inheritance which bear his name. The particulate scheme of inheritance, the working out of which has been the most striking achievement of biological science in the past twenty years, is illustrated by the breeding results in the sunflower. The red variety, which was first noticed in 1910, has been the subject of investigation by Professor Cockerell. Its breeding behavior in crosses is a clear-cut example of inheritance according to the Mendelian scheme. The discussion naturally passes to the bearers of the hereditary units, the chromosomes, and the behavior of these all-important nuclear structures is described in relation to fertilization and sex. The facts of heredity afford a solid foundation on which a consideration of organic evolution may be based, and this is the next topic treated. After a short sketch of the life and work of Darwin, his theory of evolution by natural selection is outlined, and a critical survey of the kinds of variation in organisms and their origin is given. The more strictly theoretical part of the book ends with a summary of the geological history of the earth, a discussion of the succession of animals and plants, and an interesting chapter, illustrative of fossil forms of life in general, describing the animal and plant remains found by Professor Cockerell in the Florissant shales of Colorado.

The book is unique among similar volumes in that the descriptive portion is interesting reading, a fact which adds greatly to its usefulness. This is due largely to the fact that there are no detailed morphological descriptions of typical specimens. Instead we find short accounts of the general plan of structure in the more important subdivisions under each phylum, together with a statement of the probable evolutionary relationships, and any interesting points in the natural history of individual species. Whatever the method or the material used by the individual teacher, the treatment in this section will, it may be assumed, add to the interest in addition to providing all that is usually needed in the way of reference matter. Many courses in zoölogy make no attempt to arouse interest in natural history and the observation of animals in their natural environment. Most students of college age are responsive to suggestions directed to that end, and a textbook which makes an attempt to awaken such an interest forms a valuable supplement to a course of any type. A representative instance of this is found in the treatment of the insects. After a general survey of the whole group, three short chapters are devoted to the Lepidoptera, bees, and ants, respectively; and a fourth describes the life and work of J. H. Fabre. The illustrations throughout this section are photographs from life, and are an effective aid in stimulating an interest in the study of the living animals.

The remainder of the book consists of an application of the knowledge already gained to specific problems of general interest. After a brief account of the evolutionary history of the horse and the elephant, the evolution of man is discussed and a brief anthropological sketch given. Other evolutionary problems, such as the geographical distribution of life, the characteristics of life in the tropics and in the circumpolar regions, the types of life in the sea, all receive attention. Finally certain applications of biological principles to human society are suggested. An account of the life and work of Pasteur introduces the subject of infectious disease, and thus the general question of public health is opened up. In a short consideration of history from the biological point of view the influence of disease on human evolution—a point too seldom raised—is emphasized. The general conclusions of the study of heredity are applied to the human species and the possibilities of eugenics are touched on. The book closes with an attempt to sum up and evaluate the biological contribution toward a philosophy of life.

Taken as a whole Professor Cockerell's textbook fulfills its purpose admirably. Within a volume of reasonable size it presents the important biological ideas to the general student in an interesting and thoroughly coherent manner. As a text book it may be used as the groundwork for a general course regardless of the individual treatment of the teacher. More advanced students who wish a review of the whole field will find it well worth reading. One real omission is all reference to the process of development in animals. Even though this furnishes the subject matter of a separate course, some discussion of it should fall in the course for general students. Teachers can easily supply this lack in class or laboratory demonstrations. Apart from this the book meets the needs of the newer general course with marked success.

TO THE NEW-BORN SON OF A NATURALIST

You will see, where we are blind,
We may seek, but you will find;
Yet when you hold the golden thread
Passed on from days of long ago,
The names of those rememberéd
For what they strove to do and know
May still have power to stir the mind,
And passing, leave a gift behind!

—T. D. A. Cockerell.

THREE INTERESTING BIRDS OF THE COLORADO MOUNTAINS

PHOTOGRAPHED IN THE WILD STATE

BY

CLARK BLICKENSDERFER

THE ROCKY MOUNTAIN JAY, OR CAMP BIRD

The Rocky Mountain jay or camp bird, long-crested jay, and Clarke crow are probably the three most conspicuous birds to be seen on a trip into the Rocky Mountains of Colorado.

The Rocky Mountain jay is well known to every camper who has pitched his tent in the deep, coniferous forests of the higher mountains. Hardly has the camp fire been lighted and the bacon begun to fry, when the Rocky Mountain jay with a low, plaintive cry, and a quick, quiet flutter of wings, is seen perched on a near-by branch watching one's every movement with keenest interest. If you are kindly disposed and toss him a piece of bread, he seizes it in an instant, and flies off with it through the forest, only to return for more, accompanied by others ot his tribe

THE LONG-CRESTED JAY

The long-crested jay, with its well-groomed, dark blue coat, high topknot, and white markings on the forehead and above the eyes, is constantly encountered from the foothills to timber line. Not satisfied with its rather conspicuous form and color, it forces attention by always squawking and scolding, as it moves about under the pine trees, or soars away over a low rise.

Every mountain ranch has its jay visitors, that especially delight in the chicken yard and take every opportunity to get an easy meal of chicken feed, flying into the nearest trees upon the approach of the farmer and scolding him noisily. When near a human being, these birds are always on the alert, and very reluctant to make friends; often without the slightest warning, seeming to scent some kind of danger, they will make a quick jump and take to wing with amazing speed

THE CLARKE CROW OR NUTCRACKER

This is a larger bird than the jays, with light gray head, neck, and back, and wings and tail of black, with a few feathers of pure white. A casual observer would never take these birds for crows, their heavy, black bills being their only marked resemblance to the bird of sable plumage. They are seen most often in scattered flocks, when moving to or from the foothills, where they winter, to the high, thickly forested mountain slopes, where they spend the summer, feeding as they go upon clusters of pine cones. Using their large bills, they strike the cones with great force, tearing them open and obtaining the pine nuts within. When these have been extracted, the cone is dropped and falls clattering through the branches to the ground. The noise of the dropping cones is often the first warning that one has of the presence of the birds in the trees above him.

The Clarke crow is seldom attracted to the abodes of men, but is a frequent visitor to the garbage piles of permanently located graders' camps in the high altitudes, where it is the monarch of all it surveys and even the audacious camp bird has to retreat while the Clarke crow takes its pick of the food spread out before it

Molocca or communal house.—All the Indians of a community live in one house, each family having its allotted space around the sides. The central part is used for meetings, dances, games, etc. Often there is not another molocco within 100 miles, and the rivers are the only roads

TAPIOCA—A FAMILIAR FOOD OF UNFAMILIAR ORIGIN

BY

CHARLES W. MEAD*

SOME three years ago I installed an exhibit in the Peruvian hall of the American Museum, showing how the Indians of northern South America make tapioca, their staple food. This step was taken as a part of the Museum's educational work, after I had asked quite a number of school children whether they could tell me of what tapioca is made, and had been answered either that they did not know or that it came from a palm tree.

This ignorance is not confined to children, for during the time this exhibit has been in the Museum I have not met more than half a dozen adult visitors who knew that tapioca was made from the tuberous root of the cassava plant. Two species of cassava are cultivated: the bitter cassava, *Manihot utilissima*, Linn. and the sweet cassava, *Manihot dulcis* var. *Aipi Pax.* The first, the more useful of the two, contains hydrocyanic acid and cannot be eaten in its natural state, but its nocuous qualities are quickly dissipated by heat. This is the variety from which tapioca is made. The sweet variety is innocuous and is used as a table vegetable. Both the bitter and the sweet cassava had their origin in tropical South America. The former has been introducd into many tropical countries and is very extensively cultivated in the western part of tropical Africa and in the Malay Archipelago. Its starch, in the form of tapioca, is a staple export from these regions as well as from Brazil and other South American countries. This starch is sold also under the name of Brazilian arrowroot. The roots are sometimes sliced, dried, and grated, to be made into cassava bread.

The juice expressed from the poisonous cassava is converted into a beverage

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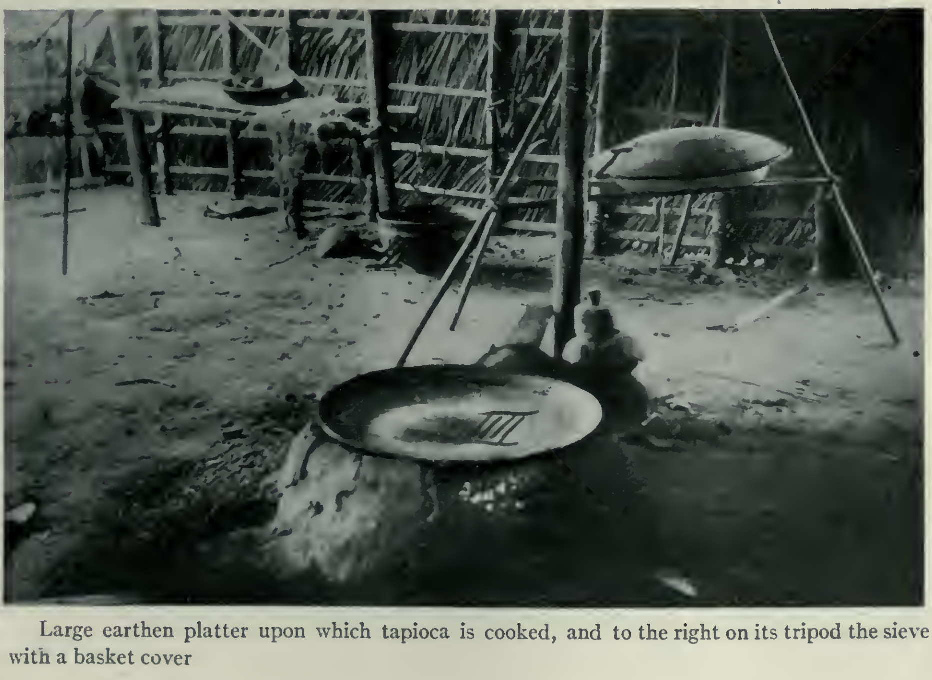
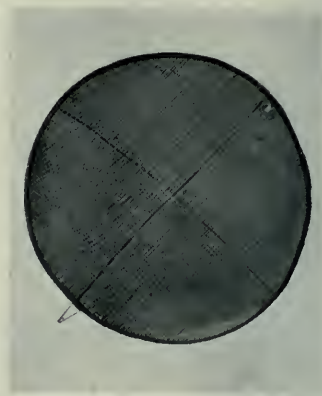
Tipiti, or press, in position.—In some localities a device is used by means of which tension is maintained on the press without having someone sit on the end of the pole. The greater the length of the pole the more is the tension exerted on the press



Large earthen platter upon which tapioca is cooked, and to the right on its tripod the sieve with a basket cover





On the left is the basket used by the women in bringing the cassava roots from the field. When in use these burden-baskets rest on the woman's back; the supporting strap passes across the woman's forehead. In the middle picture is shown a cassava grater of wood with imbedded pebbles. The sieve on the right is woven of fine strips of cane

by heating and fermentation, and by evaporation and concentration, with the addition of various aromatics, it becomes *Cassareep*, the favorite condiment of the South American Indians. *Cassareep* is imported in considerable quantities into Holland and Britain. It is the basis of the favorite West Indian dish called pepper pot.

The objects in the exhibit showing how the Indians make tapioca are a part of the results of an expedition under Messrs. Herman Schmidt and A. Weiss that was sent by the Museum to the region of the western tributaries of the Rio Negro in Colombia. The photographs show some of these objects in position, just as the Indians were found using them on the banks of the Rio Caiary-Uaupes.

The Indian woman takes a large piece of cassava root in both hands and rubs it back and forth on a board studded with hundreds of sharp pebbles until the root is reduced to pulp. When a sufficient quantity has been grated, the next step is to press as much water out of it as possible. For this purpose a long, narrow tube of basketwork, called a *tipiti*, is used. This basketwork press has a loop at either end. The pulp is forced into the press, which is then hung up by one of the loops. Through the lower loop is inserted a long, stout pole which in turn is run under some convenient object that serves as a fulcrum. The woman thereupon sits on the free end of the pole, her weight stretching out the press and forcing the liquid through the interstices of the basketwork. This liquid is caught in a pottery vessel and is then prepared in the manner stated above.

The wet mass is taken from the press and spread on a very large flat dish of pottery having a raised rim, under which a fire is built. If stirred rapidly, the preparation is prevented from caking into large masses, and quickly agglomerates into small, irregular pellets, the tapioca of commerce.

The *tipiti*, a basketwork press, is from five to eight feet long and is made of strands of palm leaf

NOTES

THIRD ASIATIC EXPEDITION

PROFESSOR OSBORN TO VISIT THE FAR EAST. President Henry Fairfield Osborn of the American Museum is on his way to the Pacific coast to board a steamer for the Far East. He will disembark at Yokohama and visit various localities in Japan. Thence he will cross to the Asiatic mainland and travel by rail through Corea to Peking, his principal destination. There he will be met by Mr. Roy Chapman Andrews and the other members of the Third Asiatic Expedition, who will at the time of his arrival have emerged from the Gobi Desert. Of such far-reaching importance are the discoveries which have been made by the expedition to Mongolia that the presence of Professor Osborn was particularly desired to the end that the plans for the future work in this area and other parts of Asia might be discussed in the light of his wide experience. Professor Osborn will himself make a personal inspection of the fossil beds in the desert of Gobi in company with members of the expedition. It is Professor Osborn's plan to go from Peking to the Siwalik Hill region of India to visit, together with Mr. Barnum Brown, some of the important palæontological areas in that region.

BIRDS

BIRD STUDY ON THE WEST COAST OF SOUTH AMERICA.—Dr. Frank M. Chapman, curator of the department of birds, American Museum, writes from Guayaquil, Ecuador, July 26, 1922, of the successful prosecution of ornithological work in the Chongon Hills, west of the River Guayas, and also among the islands, shore lines, and estuaries of the Gulf of Guayaquil. It had been the intention of Doctor Chapman, together with his associates George K. Cherrie and Geoffrey O'Connell, to travel by boat from the Gulf southward along the Peruvian coast to Payta, in order to make investigations in a region which is of particular interest, because it is on the border line between the humid tropics and the rainless Peruvian littoral. The bird fauna of the equatorial Pacific, west of South America, is decidedly different from that of the Humboldt Current region, which extends northward to the neighborhood of Point Pariña, the westernmost projection of the continent. The divisions between these two faunal regions had, however, been very slightly known for lack of intensive field work. One of the principal objectives of Doctor Chapman's trip was the island of Santa Clara, or Amortajada ("shrouded corpse"), which lies off the estuary of the River Guayas, southwest of Puna Island.

Doctor Chapman's letter states that he could find no suitable vessel for the long trip to Payta, and so when by chance an opportunity came to hire a launch for the shorter voyage to Santa Clara he availed himself of it. Leaving Guayaquil at night, the party reached Santa Clara next day but found the ocean too rough to permit of landing. There proved to be no harbor at Santa Clara, and there was no lee in the prevailing wind, while a dangerous reef could be seen a short distance to leeward of their anchorage. With a gradually increasing wind, the launch bearing the American Museum's representatives lay about 200 feet from the island in a surging sea which forced Doctor Chapman to give up his attempt to land. He then planned to go over to the Peruvian mainland, above Tumbez, but the cross sea in the gulf was too much for a launch and he finally had to run before the wind into Puna. The same night he made another attempt to get across but was once more obliged to give up after the boat nearly turned turtle.

Doctor Chapman writes that although they could not land on Santa Clara, the island, which had not previously been visited by a naturalist, has at least been put upon the ornithological map. It is a vertical rock, from 100 to 200 feet high, extremely barren with no vegetation other than scrubby bushes; it appeared not to be a likely place for land birds. Boobies, man-of-war birds, and brown pelicans evidently constituted the resident bird fauna. None of these seemed to be breeding at the time of the visit; indeed, all specimens taken on land or water were in full post-nuptial molt.

Later, the Museum's party covered both shores of the Gulf of Guayaquil, and ran up many stream courses and coves, gaining an adequate idea of the whole region. Aside from observations and photographs, they obtained many skins, adding fifteen species to the recorded avifauna of Ecuador. A particularly interesting discovery was the presence in large numbers of North American shore birds in midsummer (early July); these included Hudsonian curlews, dowitchers, black-bellied plover, and a flock of no less than 300 willet.

Doctor Chapman found the gulf climate delightful, with very few mosquitoes, and little rain. Temperature observations showed that the ocean water ranges close to 74° F., or more than 12° higher than the temperature of the Peruvian shore waters, but a short distance south of Point Pariña.

AN EXTINCT PARROT ACQUIRED BY THE AMERICAN MUSEUM.—Through the generous gift of Mr. J. Sanford Barnes, of New York City, the American Museum of Natural History has been enabled to purchase from the Zoölogical Museum of Vienna, a specimen of an extinct parrot known to science as *Nestor productus*. Only thirteen specimens of this species are to be found in all the museums of the world. The home of the *Nestor productus* was at Norfolk Island, which lies in the Pacific Ocean, several hundreds of miles east of Australia and north and west of New Zealand. The species seems to have lived both upon Norfolk Island and upon a small outlying islet known as Philip Island All the parrots upon the main island were exterminated by convicts and settlers in the early part of the nineteenth century, and it is thought that every specimen now in existence came from Philip Island, where the species survived until a somewhat later date. Under these circumstances, it is not absolutely certain that the Norfolk Island parrot was identical with that of Philip Island, but upon the basis of the early descriptions it is generally assumed that the two were the same. Lord Howe Island, which lies somewhat north and west of Norfolk Island, also had a native species of *Nestor*, which has likewise been exterminated.

The parrots of the genus *Nestor* are confined entirely to the New Zealand region, and two species, known by the native names of "kaka" and "kea" still exist in small numbers in New Zealand itself. The kea of the Maories, *Nestor notabilis*, lives in the higher mountain ranges of the South Island and has been nearly exterminated by the inhabitants because it has developed an extraordinary habit of attacking sheep, picking holes through their backs and sides with its powerful beak, so as to obtain the fat surrounding the kidneys. In the National Museum at Washington, mounted specimens are shown in the act of thus lacerating a sheep. It has been inferred that the parrots first acquired this curious habit through tasting the fat of sheep carcasses hung up after dressing, but it is probable that the accounts of their ravages on sheep have been considerably exaggerated. The normal food of all the parrots of the group consists of fruit, seeds, and the larvæ of wood-boring insects, the last being obtained by stripping the bark from trees. The parrots of Norfolk Island and of Philip Island were, of course, exterminated so long ago that they had no opportunity to acquire such undesirable habits as those evinced by the New Zealand kea.

The specimen now in the American Museum is about the size of a crow and has a characteristic long, sharp, hooked bill. Its body plumage is greenish gray, with orange or reddish cheek patches and a wide yellow breast band. Its head was figured in color by Lord Walter Rothschild in his monographic volume on *Extinct Birds* (1907). The specimen was originally bought by the Vienna Museum in 1839, thirty years before the founding of the American Museum of Natural History, from Ward, the London dealer. Through the generosity of Mr. Barnes it has now come to what is hoped will be its permanent home. R. C. M.

AUSTRALIA

Progress of the American Museum's Expedition.—Mr. H. C. Raven, the field representative of the American Museum in Australia, has recently made his way out of northern Queensland with what is described by the director of one of the Australian museums as "a very fine series of mammals in splendid condition." The material secured by Mr. Raven in the field has been augmented by exchanges, including not only mammals but other classes of animals. Mr. Raven is now collecting in the Burnett District in company with Mr. Colclough of the Queensland Museum. The generous spirit of coöperation shown by sister institutions in Australia has contributed in no small measure to the success of the expedition of the American Museum in that continent.

AN AIR-BREATHING WATER SPIDER

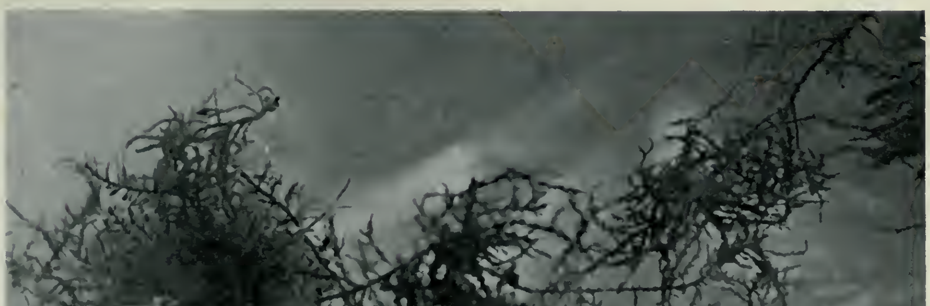
Although the spider fauna of America includes spiders more or less aquatic in their habits, like *Dolomedes*, it lacks the interesting *Argyroneta*, an air-breathing water spider that is present in Europe as well as in north and central Asia. Mr. F. H. Haines has on more than one occasion in the past kindly shipped to the American Museum specimens of this genus collected in England. The long sea voyage, during which the spiders have been confined within a tin box, has necessarily taken a heavy toll of life and the survivors have sometimes been slow to demonstrate their interesting habits. Of twelve *Argyroneta* contained in a recent shipment from Mr. Haines, six were sufficiently hardy to weather the abrupt change in their mode of living and the discomforts of an ocean voyage and reached the Museum without any pronounced loss of vitality.

The spiders were at once transferred from the tin container in which they had made the trip to a water-filled bowl, and one of them promptly celebrated its liberation by an act of cannibalism. Thereupon the precaution was taken of placing the five survivors in as many bowls, each provided with a small cork raft and some submerged plant material.

One of the specimens began almost immediately the construction of its under-water rest-chamber, a more or less ellipsoidal or dome-shaped enclosure of spider silk fastened to some water plant or other subaqueous support and filled with air that the spider brings down to it by repeated visits to the surface of the water. It was a fascinating sight to watch the spider as it worked, swimming upwards until it could thrust the tip of its abdomen out of the water and then reimmersing it immediately to return below, its body silvered by the air bubble held imprisoned in the long abdominal hairs. This bubble was released under the structure of silk

Photograph by A. Katherine Berger

The air-breathing water spider, *Argyroneta aquatica*, is seen resting in inverted position near the bottom of the glass container, its abdomen aglisten with the quicksilver-like air bubble that enables it to breathe under water. Some distance above the spider and to the left is the oval-shaped rest chamber in process of construction



Photograph by A. Katherine Berger

A completed chamber, in which the spider, her task of building ended, is enjoying a well-merited rest and with other bubbles successively added, ballooned out the tightly spun fabric until it resembled a miniature parachute. After depositing its bubble, the spider worked with its third and fourth pairs of legs, while apparently engaged in strengthening or enlarging its dome-shaped dwelling.

Stabley in *British Spiders* states that from her domicile *Argyroneta* "extends cords in various directions, which she attaches to the leaves and stalks of plants and to other objects." One of the objects used for anchorage in the present instance was the cork raft that floated on the surface of the water. To one of the edges of this raft the spider attached a taut, well-nigh vertical strand of silk along which she made her ascents and descents. When she had constructed a commodious cell and made her ascent for what at the time was believed to be her last visit to the surface, she ruptured this strand near the top and in descending rapidly to her rest chamber, disposed of the strand completely. She then entered her enclosure and holding with her front legs to its sides, worked hard with her third and fourth pairs of legs, presumably putting the finishing touches upon the architecture.

After being engaged in this way for some minutes she rested, becoming, in fact, totally inert. She remained motionless for twenty minutes and as the act of building seemed definitely at an end and the hour was getting late, observations were abandoned. Great was the surprise, therefore, when on the morrow it was noted that in the interval she had enlarged her air chamber by at least a third, and, what was equally interesting, she had replaced the broken strand by another.

As the days went by several of the other spiders built retreats. Sometimes these were placed against the glass of the aquarium, as shown in the lower picture on p. 473, at other times they were constructed in the submerged plant material as indicated in the upper picture on the same page; not infrequently they were built on the underside of the frail rafts of cork.

On the morning after the arrival of the spiders a fly was caught and thrown into one of the bowls. At first the spider thus favored seemed rather indifferent to the insect that was skating frantically about the surface of the water. Then she seized it and holding it tightly in her jaws, swam below and placed it against a water plant, while she went to inspect her cell. For some reason the structure failed to win her approval and accordingly she proceeded to build a new banquet hall. When this had attained satisfactory proportions, she swam over to the fly and with much labor—for the fly was a bluebottle and much larger than its captor—bore it into the chamber prepared for its reception.

The cell had been constructed beneath the raft. In the afternoon the wind that blew through an open window caused miniature waves in the bowl and these, in turn, disarranged the raft with the resulting partial collapse of the cell. Thereupon the spider, deciding perhaps that all the titbits of the fly had been consumed and that what remained was not worth her efforts, removed the fly and swam with it a considerable distance through the water. The fly had been partly dismembered; one of the wings was torn off and some of the legs were detached.

Later in the day another fly was placed in the same bowl and after a short interval was attacked by the spider, which seized the insect by the fore part of the body and carried it to her cell. Again the wind proved a disturbing element, resulting in this case in the complete collapse of the cell. Just prior to this catastrophe the spider had gone to the surface to bring down an air bubble for the purpose of enlarging her domicile. On descending to the scene of the disaster she seemed much mystified to find nothing but sodden cobweb where before was a well-proportioned building. She took her fly and swam around in a distracted manner for some time. Then she approached the edge of the raft from below and obtaining a precarious foothold for two or three of her flexible appendages, tried desperately to lift herself and her burden out of the water. Failing in the attempt, she thereupon built a new cell to accommodate the prey.

Another spider, having longer legs which offered better leverage, succeeded in lifting her fly upon a raft and proceeded to suck the juices.

On many occasions the spiders exhibited their interesting building habits, and in watching them it was hard to decide which was the more wonderful,—the device whereby nature has enabled these little air-breathing creatures to escape drowning when they submerge themselves for long periods, or the fact that they should choose such a strange medium as water in which to build their silken-roofed homes.

INSECTS

Recent Field Work on Insects.—Dr. F. E. Lutz, curator of entomology, American Museum, spent the summer in the vicinity of Boulder, Colorado, continuing the field work which he has been doing in connection with the wild bees of Colorado and carrying on investigations as chairman of the National Research Council's Committee on the Biological Relations between Flowers and Insects. On the return trip Professor T. D. A. Cockerell, of the University of Colorado, accompanied him as far as Lincoln, Nebraska, in the field-automobile of the department of entomology. Short stops were made for collecting with the result that seven species—two new to science—were added to their manuscript list of about eight hundred different kinds of wild bees in Colorado.

FISHES

THE "BIBLIOGRAPHY OF FISHES."—The monumental *Bibliography of Fishes*, a work inaugurated in the American Museum many years ago under the inspiration of Curator Bashford Dean, is now nearing completion. Doctor Dean himself devoted many years to this bibliography; it was taken up with enthusiasm and devotion by Dr. Charles Eastman, formerly of Harvard University, and a learned student of the fishes. On the lamented death of Doctor Eastman, Doctor Dean invited Professor E. W. Gudger, of North Carolina College for Women, to continue this important work. The first volume of titles was brought to a close in 1916 and the second volume in 1917, the printing being admirably done for the Museum by the University Press of Cambridge, Massachusetts. Since 1917 Mr. Arthur W. Henn, curator of fishes at the Carnegie Museum of Pittsburgh, now on leave of absence from that institution, has been coöperating with Dr. Gudger in the preparation of the third or index volume, which is now nearing completion. This index is quite without parallel in biological literature; it opens up the subject of ichthyology from every angle, not only from that of natural history but also from that of medicine, of history, of chemistry, and of art. As to the precision with which this work has been accomplished from a strictly bibliographic standpoint, the Museum has recently received a testimonial of the first order from Dr. H. M. Lydenberg, reference librarian of the New York Public Library, who under date of July 17, 1922, writes to Doctor Dean as follows: "Yesterday afternoon it was my rare privilege to spend several hours going over the subject index to the bibliography of fishes now being prepared by Dr. Gudger. The personal interest I have felt in this bibliography, knowing both Eastman and Gudger as I have, must serve as an explanation of why I venture to write you now. I do not care to let the day go by, however, without expressing my congratulations on the conception of the bibliography and the index, and also on the admirable way in which this conception is now being realized. This work, once finished, will certainly fix a standard for future enterprises of like importance; and I am sure that the scientific world will owe you a debt of gratitude for having made possible this contribution to the two sciences of ichthyology and bibliography." H. F. O.

CUSK EELS.—Before his death Mr. William W. Welsh, of the United States Bureau of Fisheries, had gathered together a collection of miscellaneous fishes, taken in the Gulf of Mexico by the "Grampus," one of the boats of the Bureau. This collection has been sent to the American Museum where it is being worked up by Mr. John T. Nichols, curator of recent fishes, and Mr. C. M. Breder, Jr., who prior to becoming connected with the New York Aquarium was assisting Mr. Welsh in the study of this very material. The first results of the investigation have been published under the joint names of Mr. Nichols and Mr. Breder in the *Proceedings of the Biological Society of Washington*. The paper is a contribution to our knowledge of American cusk eels, which because of their rarity and because of the fact that they are found in water of some depth have been very imperfectly known. The three genera considered,—one represented by a new species, *Otophidium welshi*,—show a peculiar tendency in the degeneration of the scales. *Lepophidium* is the most generalized of the three and the scales, although very small and arranged in an unusual way, are yet like those of normal fishes. The scales of the more specialized genera are, on the other hand, rudimentary, embedded, and linear, and are arranged in groups that are approximately perpendicular to one another,—a condition identical with that in the common eel and a very striking case of parallelism if, as is believed, the eel is in no wise related to these cusk eels.

In return for the facilities extended by the American Museum in this investigation, some valuable specimens of the species examined have been obtained from the Bureau of Fisheries.

VERTEBRATE FOSSILS

COLLECTING FOSSILS IN SUN-SCORCHED INDIA.—With the aid of a generous contribution from Mrs. Henry C. Frick, the American Museum has sent one of its most highly trained and expert field collectors, Mr. Barnum Brown, into the classic region of the Siwalik Hills of western India. Mr. Brown was most cordially received and aided by Dr. C. E. Pilgrim and other officers of the Geological Survey of India. Doctor Pilgrim first directed Mr. Brown's work toward the Middle Siwaliks where an extremely valuable collection of fossil mammals of many kinds was secured.

As to fossil collecting in India during the torrid season, Mr. Brown writes President Osborn, June 21, 1922: "After many weary days of vexatious delays and difficulties, my Middle Siwalik collection is at last boxed and stored in the railroad station at Chakwal ready for shipment to Calcutta. I have arranged to keep it there until I bring in whatever I collect from the Lower Siwaliks at Chinji, and send all together in a separate car straight through. It will cost double freight, but I don't dare risk having coolies shift these heavy boxes at three transfer stations. . . . Some of the difficulties I have encountered in making this collection will interest you. It took one week to build a passable road for carts out of the bad lands, and then required four bullocks and twenty-one men to move each mastodon skull. Fourteen days were consumed in transporting these skulls sixty-five miles, thirty-five of which were without road. The Indian countryman does not know how to work except in the grain field, and as he eats nothing but bread and chili, he has the strength of a small boy. . . . Traveling is done at night now for the daily temperature in the Punjab averages from 100 to 115 in the shade and around 200 in the sun. It is the most taxing heat I have ever endured. . . . It is difficult to secure adequate boxing lumber for big specimens. Parts of my material came from America, and the rest had to be sawed by hand on the spot. I have used flour paste for bandages, as plaster is not obtainable.

"I collected thoroughly all the Middle Siwalik series for a distance of twelve miles up and down the Sohan River from Dhok Pathan, and there are equally good exposures yet untouched for a distance of ten miles above where I worked. I doubt, however, if many species new to our collection would be obtained by further work in this region, so will go on to the Lower Siwaliks at Chinji. . . . The big specimens have used up much more time than I anticipated, so I am far behind my schedule, but unless I hear from you to the contrary, I shall continue my itinerary as projected, namely, the Lower Siwaliks at Chinji, afterwards the Upper Siwaliks at Chandi and Moganand, the type locality of the early Siwalik collections. This will give us representative collections from the Upper, Middle and Lower series. On account of the heat at present the Bugti Hills are impossible until later in the year, so I have decided to await your further advice."

Restoring the Fossil Mammals and Men.—The American Museum has been endeavoring to give scientific value to its restorations of extinct mammals and reptiles ever since the first efforts of this kind were made by Mr. Charles R. Knight in 1906, under the direction of Professor Henry Fairfield Osborn. This explains why the restorations are regarded as standards of their kind in many of the museums of the world and are eagerly sought for by journalists. As our knowledge of the animals is increased or modified by discovery, the original restorations are replaced by others embodying the new information. Professor Osborn is planning with Mr. Knight to revise the entire series, which now includes upward of fifty mammals and reptiles, bringing all the restorations abreast with our most recent knowledge. The comparative anatomical study of extinct animals, introduced under Curator William K. Gregory and under his direction carried to such a point of perfection by the late Mr. Erwin Christman, and the fact that Curator Gregory's students have been devoting a great deal of time, with important results, to the study of comparative anatomy and the musculature of vertebrates, have placed the Museum in a position to reach a still higher degree of accuracy than ever before. The knowledge at its disposal has been expressed in very carefully prepared models like the *Camarasaurus* and *Brontotherium*, figured in Natural History, November-December, 1921, pp. 620-25.

The restorations of fossil men by Dr. J. Howard McGregor, research associate in human anatomy, American Museum, have been based on sound scientific principles; in fact, they embody the most carefully revised and exact measurements and the most thorough methods that have ever been instituted for work of this character. The restorations of the heads in particular of these fossil men have passed through several stages as our knowledge has been perfected by successive discoveries. The result is that the models that Doctor McGregor has made of the Trinil man (*Pithecanthropus*), of the Piltdown man (*Eoanthropus*), of the Heidelberg man (*Homo heidelbergensis*) and of the Neanderthal man (*Homo neanderthalensis*) and finally of the Crô-Magnon man (*Homo sapiens cromagniensis*) are eagerly sought for by museums in various parts of the world, and have been of especial value to educators and to journalists.

The American Museum is now undertaking a far more difficult and expensive task in the complete restoration of the body of Neanderthal man, having sent Doctor McGregor on a special journey across the Atlantic to study all the European collections with a view to securing the fullest data and by purchase and exchange enriching the Museum collection of casts and replicas. There are still many misconceptions regarding the pose, the stature, and the bodily appearance of Neanderthal man which Doctor McGregor is in a position to correct as an outcome of his long and intensive research. He is now engaged in putting together the results of all his observations and measurements and in modeling a complete skeleton of Neanderthal man, which, when ready, will be placed in the hall of the Age of Man, beside the complete restoration of the body, above alluded to, on which he is also engaged.

GEOLOGY

Award of the Gaudry Medal to Professor Osborn.—Just at the close of the World War the Société géologique de France awarded the Albert Gaudry Gold Medal, the highest distinction which the society confers, to Professor Henry Fairfield Osborn, honorary curator of

The Gaudry Medal of the Geological Society of France, awarded in 1918 to Dr. Henry Fairfield Osborn, honorary curator of the department of vertebrate palæontology, American Museum, in recognition of his work in geology and in palæontology

the department of vertebrate palæontology, American Museum. The medal has been received recently by Doctor Osborn, accompanied by the following letter from President A. Lacroix of the Society:

Paris, July 11, 1922.

My dear Colleague:

The Société de géologique de France awarded to you in 1918 the Gaudry Medal. In selecting you, during the progress of the war, as the recipient of the highest distinction within its power to express, it wished to evidence to you the esteem in which it holds your fine scientific works and at the same time to express most cordial interest in American science.

I am pleased that the fact of my being president affords me the privilege of transmitting to you this tangible evidence of the admiration of your colleagues, the French geologists. The Ambassador of the United States has graciously undertaken the delivery of our gift. I am certain that this proof of good feeling will enhance the award in your eyes.

Accept, my dear Colleague, the assurance of my high respect and of my very cordial good wishes.

The President of the Société géologique
Secretary in perpetuity of the
Académié des Sciences
A. Lacroix.

"THE ORIGIN AND EVOLUTION OF LIFE"

A French Estimate of Professor Osborn's Work.—A French translation, prepared by Félix Sartiaux, of Professor Henry Fairfield Osborn's *The Origin and Evolution of Life* recently made its appearance under the imprint of Masson et Cie of Paris. The book has been warmly received by French scientific circles and citation may be made from a representative review published in the Paris *Temps*:

"The theory which Dr. Henry Fairfield Osborn, the eminent palæontologist, president of the American Museum of Natural History, propounds in a book of commanding interest doubtless does not escape the charge of being an hypothesis. It must be considered, however, as representing, according to the new physico-chemical conceptions and the recent researches regarding colloides, the point reached by our actual knowledge. It is certainly a remarkable effort toward a scientific comprehension of that which one might be tempted to place in the domain of the unknowable if one had not accustomed one's self to being astonished no longer by any discovery of science, however unexpected."

After a survey of various phases of the book, the review closes as follows:

"We are not able to follow the author through that captivating vista of the evolution of living forms, passing from algæ to the higher plants, then to the animals. Our too brief summary consequently gives only an imperfect idea of the grandeur of the structure he has been able to erect and of which the theory of the origin of life is only the beginning. In the course of the work organisms of the most complicated type are considered from the standpoint of energy, as well as from the morphological viewpoint. The undeniable ability of Osborn gives to this part of his study a very special value, and nothing is more interesting than his conception, to which we can only allude, of the great problems of heredity. His explanation of life will doubtless have influence in turning many research workers towards that study of colloides upon which we rightly base great hopes."

Foreign Recognition of the Accomplishments of the American Museum.—Apropos of the translation into French of *The Origin and Evolution of Life*, it is of interest to cite a passage from the preface by Félix Sartiaux, the translator, in which the notable development of the American Museum of Natural History under the presidency of Professor Osborn is given full recognition.

"Palæontologist of the United States Geological Survey, president of the New York Zoölogical Society, president of the Marine Biological Association, Professor Osborn has made the American Museum of Natural History a great center of information, maintaining constant relations not only with the scholars of America and of foreign lands, but with travelers, whom he interviewed before their departure and questioned upon their return, with captors of animals, with those organizing public gardens or making zoölogical collections. The knowledge gathered has been disseminated among the public through conferences, through guide books constantly kept up to date, through fine periodicals remarkably illustrated, such as *The Journal of the American Museum* and its successor, NATURAL HISTORY. A museum planned in this manner is not a mere shrine to which repair a few initiates; it is a hearth of life, an institution ever progressing, constantly undergoing renovation, an instrument of education and of national improvement. The scholar and the man of action are thus represented in the productive activity of Doctor Osborn, who has exercised a powerful influence upon the biological circles of America and has contributed to the founding in that country of a flourishing school of young palæontologists."

MAMMALS

Mammal Collecting in Ecuador.—Mr. G. H. H. Tate has been for some months in Ecuador collecting mammals, and to some extent reptiles and batrachians, for the American Museum. His search has taken him from sea level to altitudes more than twelve thousand feet in height. Here weather conditions were often unusually severe, the nights being intensely cold, and rain and mist adding to the collector's hardships; but full of perseverance, he wrote: "I wanted the highest point where life was at all bearable."

In a shipment just received from Mr. Tate are about three hundred mammals, including species undoubtedly new to science in addition to others that are scarce. Among the latter are three specimens of the rare marsupial *Cœnolestes*, which was for a long time known from only one or two specimens and the habitat of which was a matter of conjecture. In recent years, however, more has been learned of this primitive creature through specimens taken by Dr. W. H. Osgood in Venezuela and by Mr. Edmund Heller in Peru.

A number of bats were collected in the course of the trip. Some were found in a baggage room in the station at Duran, others were obtained from a disused textile factory in Cuenca. What was described to Mr. Tate in Pescado as a cave big enough to hold a hundred men and from which a large haul of bats was to be expected, proved on examination to be merely an overhanging ledge of granite in the face of a cliff and yielded no bats whatever.

Although a large number of the smaller mammals have been secured by Mr. Tate, the larger cats and bears have as yet evaded him. He has, however, seen the tracks of both and in one instance had a striking demonstration of the voracity of the jaguar. All that remained of the wild pig that the huge cat had killed was the hair. In the scuffle that had preceded the act of devouring, the jaguar had had one of its claws torn out and this Mr. Tate preserved.

Mr. Tate was recently joined by Mr. H. E. Wickenheiser, who will act as his assistant. Mr. Wickenheiser is a Cornell student interested in natural history, who plans to return to his Alma Mater in the spring.

A RECENT CONTRIBUTION TO THE DISCUSSION OF EVOLUTION

An Address by Dr. W. W. Keen.—In the commencement address delivered before Crozier Theological Seminary, June 6, 1922, and subsequently published in the *Public Ledger* of Philadelphia, Dr. W. W. Keen, the distinguished surgeon, made a notable contribution to the discussion of evolution. The many fundamental resemblances which the comparative anatomist finds between the human structure and that of animals superficially different from man are a convincing proof of the solidarity of the animal kingdom, inclusive of man. During the fifty-five years that Doctor Keen has been practising his profession, he has been able again and again to diagnose human ailments of baffling character by applying to them his knowledge of the location of the motor centers in animals. Experiments on animals having revealed just where lie the centers that control the muscles of the face, the arm, and the leg, it is possible by analogy to determine what portion of the brain has been injured when—for instance, through a blow upon the head—a human individual has lost the motor control of one or another of these parts. The fact that the location of these motor centers is the same in man as in the animals is a striking bit of evidence of their relationship.

Wild antelope coming up to the feeding ground on the Mount Dome Antelope Refuge, Siskiyou County, California. This refuge was established November, 1921, under the auspices of the California Academy of Sciences, the California Fish and Game Commission, the United States Forest Service, the New York Zoölogical Society, and the American Bison Society

AN ACQUISITION TO THE OSBORN LIBRARY

A Gift of "Brehms Tierleben."—The American Museum is greatly indebted to Dr. Alfred Lotichius, of Frankfort on the Main, a life member of the Museum, for his gift of the complete set of the fourth edition of *Brehms Tierleben.* This splendid work covers the entire natural history of the world; it contains 2000 text illustrations, 500 beautiful colored plates by the leading artists of Germany, and 13 maps of geographic distribution. The Osborn Library has recently received from Doctor Lotichius six additional volumes, bringing the series up to the thirteenth volume, published in 1916, and including the Mammalia of the world, with beautiful illustrations of some of the newer forms of mammalian life, like the okapi. The American Museum keeps in close touch with the remarkable Senckenberg Museum of Frankfort, of which Doctor Lotichius is one of the trustees, and Professor zur Strassen, the director.

CONSERVATION

The California Academy of Sciences.—Through a committee of which Mr. M. Hall McAllister is chairman, the California Academy of Sciences is actively interested in preserving the valley elk, the mountain sheep, and the antelopes. The elk and the sheep are able to forage for themselves and need only protection; but the antelopes, because they are more and more restricted territorially, have to be fed and cared for through the winter. There are now in California five bands of antelopes, totaling 200 animals; one band of valley elk, consisting of 350 animals, and 100 elk in paddocks; and 20 or more flocks of mountain sheep, comprising possibly 1000 head, in the desert mountains of southern California and the Sierras. To calculate the number of mountain sheep with even approximate accuracy is necessarily a very difficult task, but it is one which the committee in question has set itself as a part of its labors. Through the courtesy of Mr. McAllister NATURAL HISTORY is able to reproduce a picture of the Mount Dome herd of antelopes in "company front" formation. This herd, Mr. McAllister states, is the finest, most compact, tamest, and most accessible herd in the West, barring possibly the Yellowstone Park herd.

OTHER INSTITUTIONS

The Public Museum of the City of Milwaukee.—In addition to its *Annual Reports* and its *Bulletins*, the Public Museum of the City of Milwaukee will henceforth issue a *Year Book*, in which will be presented in popular form accounts of the field expeditions and similar activities of the institution, the acquisition of collections, the installation of new exhibits, and special studies in which the various departments may be engaged.

The initial number of this new publishing undertaking, edited by Dr. S. A. Barrett, sets a standard in respect to substance and form which, maintained in subsequent issues, will give the series an assured prestige. In addition to a number of handsomely illustrated articles written by the scientific staff, recounting recent field work undertaken mainly in Wisconsin, there is a contribution by the librarian, Dr. Carl Thal, tracing the early history of the Public Museum.

In 1857 a German educator, Peter Englemann, who was himself an enthusiastic student of nature and who desired to kindle that interest in others, was instrumental in establishing the Naturhistorische Verein von Wisconsin. The collections of this natural history society grew so rapidly that by 1882 the society was no longer in a position to take care of them adequately. It was then that, through an enabling act passed by the Wisconsin Legislature, the directors of the society were authorized to convey their collections to the city, and the city through a supplementary act was empowered to receive the objects transferred.

In 1883, the Board of Trustees of the Museum that came into existence under these circumstances, elected as its first president General F. C. Winkler. During the succeeding seven years the museum grew rapidly through purchases and gifts, and the need for additional exhibition space became a pressing one. In 1890 the present site of the museum on Grand Avenue was purchased by the city of Milwaukee, and in 1896 work on the edifice was begun. An important development took place in 1906 when the Common Council passed a resolution establishing an Historical Museum as part of the Public Museum. The Historical Museum, erected on a site adjoining the original building, was completed in 1912.

The Public Museum performs an important educational service. About 90,000 people annually attend the lectures given under its auspices, and lantern slides, motion picture films, and specimens are supplied by it to the schools and other educational agencies.

International Commission of Eugenics.—A meeting to discuss the various administrative matters of the International Commission of Eugenics was held in Brussels, Belgium, from October 1 to 9.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Annual Members: Mesdames Francis J. Danforth, H. R. Miller; Doctors H. G Kugler, Ernst Lehner, Louis Vonderschmitt; the Rev. Geo. G. Hollingshead, D.D.; Messrs. Harry B. Cantor, George A. Eyer, Jr., Harry L. Ferguson, Howard Crosby Foster, Carrol H. Huddleston, Clarence Van S. Kip, Fred. H. Peper, Jr., William L. Ransom, and Rufus W. Weeks.

Associate Members: Mesdames Frederick A. Geier, Mabel Strong Heselton, Julia S. Lucky, J. F. Merrill; the Misses Dorothy Bailey, Edith West; Dr. Maurice V. Tyrode; Prof. Jack J. Hinman, Jr.; Messrs. Newton G. Armstrong, Chas. H. Baker, R. R. Bane, Charles L. Barrett, Wilbur L. Brown, Stephen Demmon, Dudley Grant Hays, Herbert K. Jones, Joseph N. La Rue, Marshall L. Murray, Karl A. Pember, J. M. Rogers, C. G. Schluederberg, H. W. Schmidt, James Scotford, Frank N. Tandy, R. G. Vaughn, and H. E. Wilson.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

NOVEMBER–DECEMBER, 1922

[Published December, 1922]

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Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

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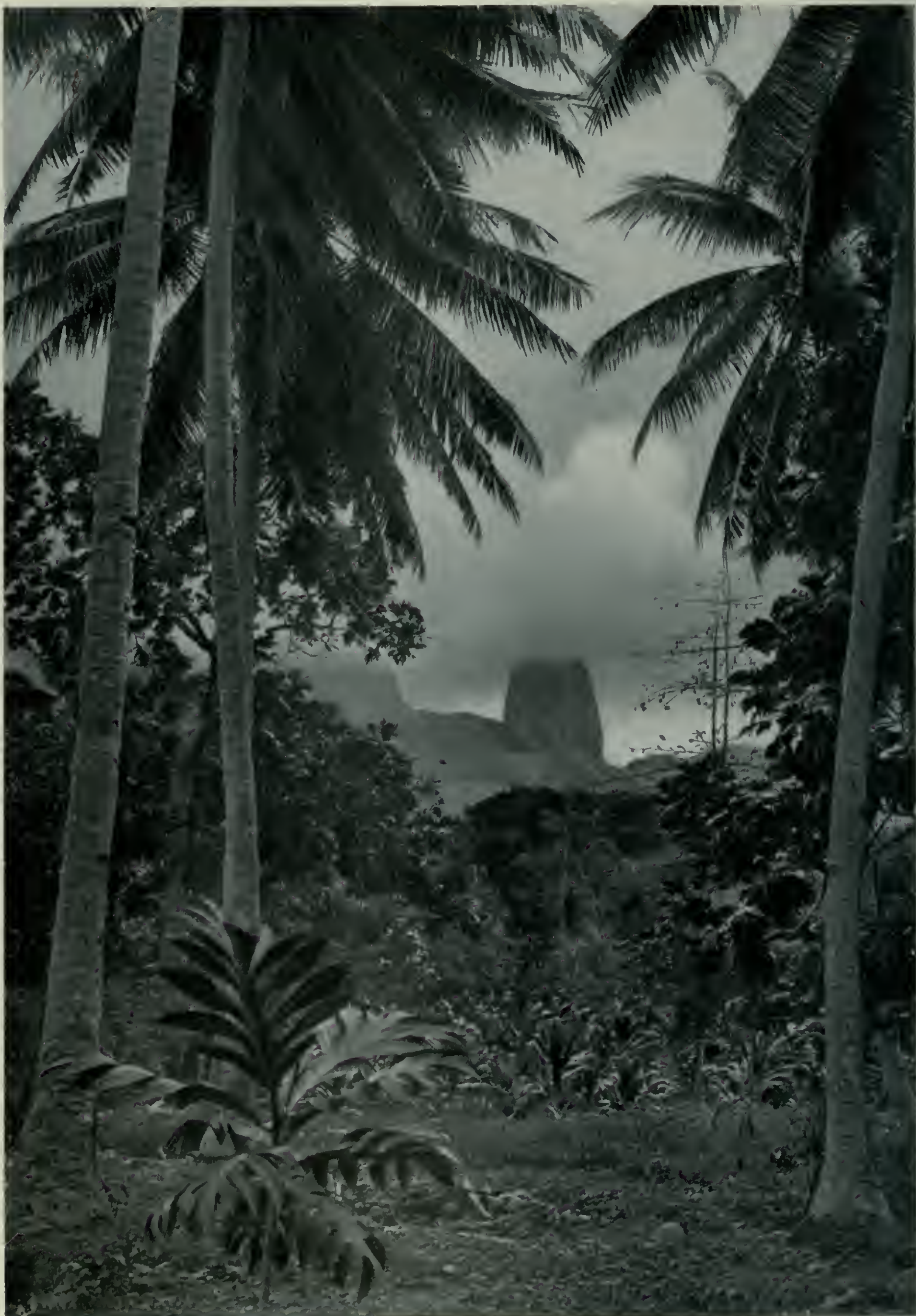


LOOKING WESTWARD AT ONE OF THE PEAKS ON HUAPU ISLAND

A beautiful little parrakeet (*Coriphilus smaragdinus*) is found only in Huapu. It was there, too, that the leader of the Whitney Expedition observed a lone specimen of the sanderling (*Crocethia alba*)—a North American shore bird for which he had been on the lookout ever since his arrival in the South Pacific

NATURAL HISTORY

VOLUME XXII NOVEMBER–DECEMBER, 1922 NUMBER 6

BIRD COLLECTING IN POLYNESIA

EXPERIENCES OF THE WHITNEY SOUTH SEA EXPEDITION AMONG THE TUAMOTU AND MARQUESAS ISLANDS

BY

ROLLO H. BECK*

WE HAD been voyaging for several days in the schooner "Hinano" among the Tuamotu Islands, a low-lying group of the South Pacific, named not inappropriately by the early navigators the "Dangerous Archipelago." At Niau, the first of our stops, I had secured specimens of three land birds—a warbler (*Conopoderas sp.*) a kingfisher (*Sauropatis sp.*), and a dove (*Ptilopus coralensis*)—different in some respects from the related species of Tahiti. In Fakarawa Island, where the governor of the thousand-mile stretch of Tuamotu Islands lives, the only land birds seen were warblers, although several terns and a white reef heron (*Demiegretta sacra*) were noted along the lagoon shore.

On our way from Fakarawa to Takaroa we sailed at the sunset hour for several miles along the low, barren reef of broken coral that characterizes the southeast side of Aratika Island, thus obtaining a close-up view of a typical atoll. At places the rock was covered with a few inches of water and on one slight elevation where a single coconut tree and a few low bushes offered shelter, a flock of large, dark-brown boobies (*Sula leucogaster plotus*) were settling for the night. A mile farther along the coast, three coconut trees and their surrounding bushes served as a place of refuge for a flock of noddy terns (*Anous stolidus*) while above soared several frigate birds (*Fregata minor palmerstoni*) which were also getting ready to settle for the night. A reef heron flew along and alighted on the outer edge of the reef, perhaps to watch for small fish that the shallow water protected from larger enemies, and a wandering tattler (*Heteractitis incanus*) winged its way above the surface of the water seeking a place shallow enough to come to rest but, finding none, was forced to continue inland before alighting.

Takaroa, our next place of sojourn, has been occupied for more than twenty-five years by a Mormon mission, and the church, with its pretentious cupola, is the most conspicuous building on the island and the only one that was left by the hurricane of 1906, the ravages of which are still traceable.

After leaving this port we sailed down the coast a few miles before bringing the "Hinano" to a stop. A boat was then sent ashore for the purpose of obtaining a load of firewood and coconuts. The engineer, his wife, and I utilized this opportunity to step on shore. As we neared the landing it was interesting to watch the numerous sizable fish that were washed up with every incoming swell and that were permitted to swim a few yards before being swept back again into the deep water beyond the precipitous wall of coral that opposes the agitated blue sea. The engineer, armed with a five-pronged spear, jumped out of the boat

*Leader of the Whitney South Sea Expedition.

before we were fairly on the reef and had plunged the weapon into a ten-pound fish while we were still engaged in pulling the boat slowly shoreward through the shallow water. In the course of an hour his sugar sack was half full of fish, most of them weighing a pound and a half, but some a great deal heavier.

From a distance I saw his wife wielding the spear and heard her squealing with laughter as she ran splashing after a school of fishes twelve inches long which had been headed off from the edge of the reef and were swimming erratically back and forth with their dorsal fins out of water and a curling wake to show where they had just been. The greater number went through the water so much faster than the laughing girl that they had but little difficulty in evading her casts, but she managed to capture a couple before the main part of the school had reached safety in the deep water.

We returned to the "Hinano" with our varied load and after beating to windward for eight days, we reached Nukuhiva Island, a member of the Marquesan group, about four hundred miles to the northeast.

The dry-looking vegetation on the west side of the island gave place to bright green as we neared the rainy quarter on the south, and as we approached our anchorage, several heavy showers came sweeping up from the southeast, penetrating the narrow bays and dropping their waters on the luxuriant growth that covered that portion of the mountainous shore line.

We cast anchor a short distance off the beach and glancing shoreward I distinguished the figures of Doctor Brown and his wife, botanists from the Bishop Museum of Honolulu, standing on the porch of a modern-looking cottage, which had served them as a base for

A tiny cove on the lagoon shore of Takaroa Island, showing low growths with coconut trees towering over them. Beautiful indeed are these graceful trees as they breast the breeze that bends back their fronds. But the havoc wrought by storms is sometimes great. The ravages of the hurricane of 1906 are still traceable in parts of Takaroa several months' work in the islands. Going ashore, we were able to make good our promise of the previous spring, to visit them in their Marquesan laboratory. In a large case on the wall and on the tables were piled hundreds of papers containing botanical specimens, and in one corner of the commodious room were dozens of small vials and larger bottles filled with seeds and fruits of the island plants. In the bushes and trees outside the house warblers (*Conopoderas sp.*) were pouring forth their melodies, while along the roadway a couple of the island swifts flew back and forth, picking out of the air their evening meal of mosquitos.

Mrs. Beck accepted the invitation to remain ashore, but I was compelled to return aboard to make ready for an early start on the morrow, as I wanted to do some collecting before we set sail the next evening for Hivaoa Island. It was there that the government administrator of the Marquesas, who had accompanied us from Papeete, had his residence. The administration headquarters had formerly been at Nukuhiva, but the presence of hosts of nonos, a mean midget fly the bites of which raise welts far larger than those produced by the mosquito, prompted the officials to transfer their offices to Hivaoa, an island lying to the southeast, where they would be exposed merely to the milder torment of the mosquitos.

Going ashore at daylight, I followed a steep trail that led across the mountains to Taipe[1] Bay, the scene of Melville's tale of Marquesan life in the nineteenth century. Ripe, juicy mangoes were lying in the trail under a spreading tree; bananas were abundant on the cañon sides close to the stream; and breadfruit trees were seen in every yard as well as in the forest that fringed the trail. The houses that I passed were mostly frame buildings with galvanized iron roofs and several had troughs to carry the rain water to barrels at the corners of the buildings.

As on the previous day, heavy rains fell at frequent intervals and I was soaked to the skin when I returned after lunch bringing with me a few warblers and a swift (*Collocalia thespesia*) that I had bagged during the morning. The large pigeon (*Serresius galeatus*) of Nukuhiva lives only on the dry western side of the island and does not occur on any of the other islands of the Marquesan group; the white-crowned dove (*Ptilopus dupetitthouarsii*), on the other hand, is common on all of the larger islands.

We left in the evening for Hivaoa and, after a stormy passage of three days, covered the sixty miles of water that intervened, entering the Bay of Traitors at midnight. Bright and early next morning the administrator was set ashore at the picturesque landing place. It was here that later in the day I saw a sailor tumble into the swirling water while trying to pass a box—part of some Chinese baggage—to another sailor, stationed in an unsteady boat that was bobbing back and forth against the face of the rocks. The sailor in the boat concerned himself with the recovery of the box, which was floating about in the water, while his drenched companion grasped the gunwale, pulled himself on to the rocks again, and resumed the passing of the baggage into the boat with no further thought of his involuntary ducking.

At four in the afternoon we got under way again for Huapu Island, which lies to the west of Hivaoa, and arriving there at an early hour in the afternoon of the following day, I had an opportunity to go ashore with my camera while the supercargo made inquiries about copra. As we rode in to the beach on the crest of a swell, a small bird rose from the sandy shore and I recognized it at once as a sanderling (*Crocethia alba*)—a North American shore bird that I had been looking for ever since our arrival in the South Pacific. A week later I secured a

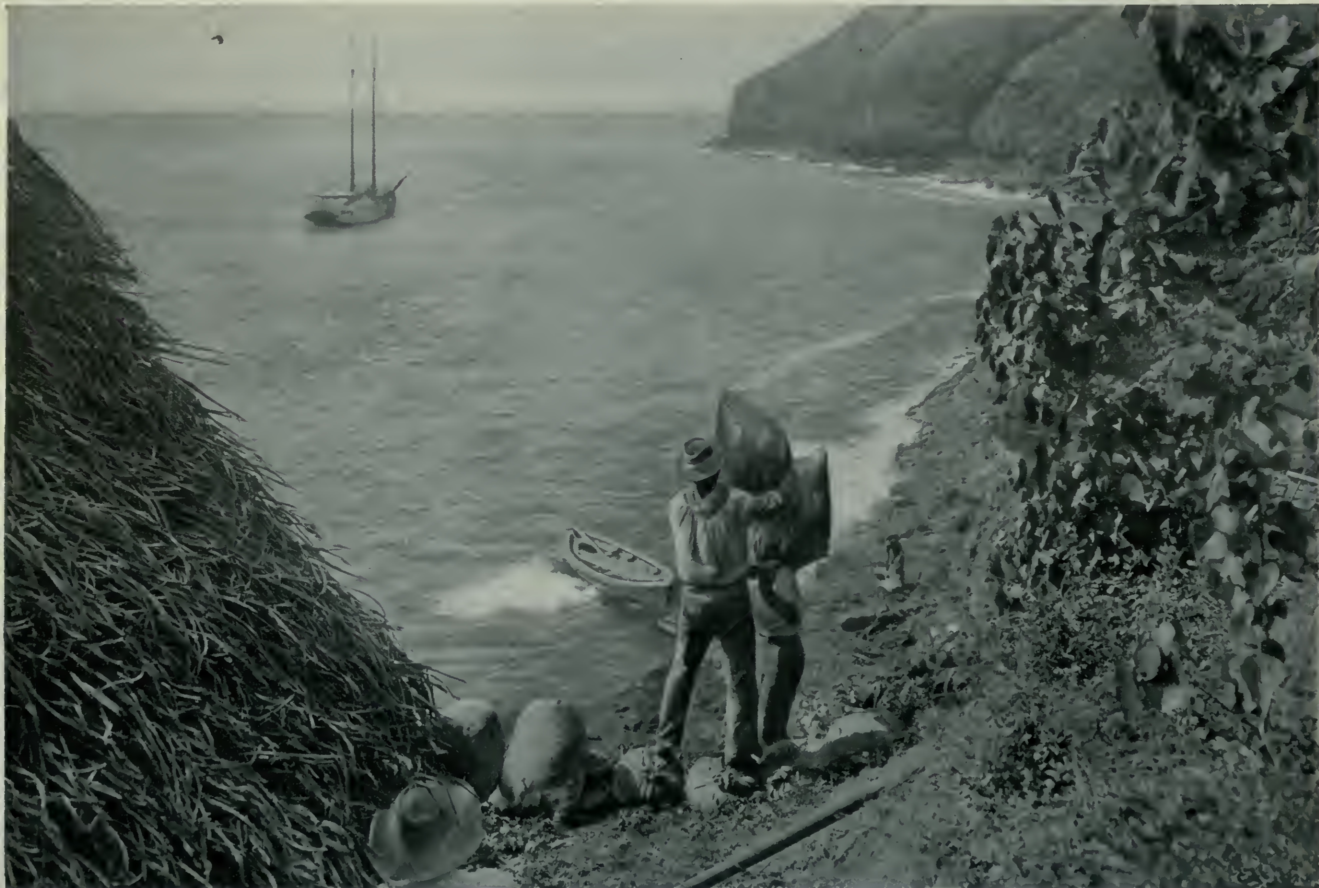
[1]Typee is the spelling used by Melville and is the title of his book.

HIVAOA

Three days were consumed in fighting the mountainous seas between Nukuhiva Island and Hivaoa,—a welcome place of refuge for the storm-tossed travelers

HATIHEU BAY, NUKUHIVA ISLAND

These splintered peaks, with jagged summits silhouetted against the sky, hold the vision as one glances westward along the beach at the head of Hatiheu Bay



GATHERING COPRA ON THE NORTH SHORE OF HATIHEU BAY

Copra—the dried meat of the coconut—is an important article of export from not a few of the Polynesian Islands

SCENE ON THE NORTH SIDE OF NUKUHIVA

The picture shows a little settlement at the head of one of the numerous bays that indent the shores of this island

This old stone wall on Huapu Island is a relic of a former generation. The forest growth soon encroaches on these masses of masonry, and sizeable trees, like the papaya here shown, raise themselves in token of conquest above the works of man

Some of the old foundations built by former generations of Marquesans still serve the present generation specimen on Nukuhiva, this being the fifth species that I felt sure had come all the way from Alaska to visit this region and thus avoid the northern winter.

In a wide-mouthed valley there were a few houses encompassed by numerous breadfruit trees and coconut trees, and everywhere about this settlement grew wild cotton plants, indicating that while the Civil War was raging in the United States, cotton growing may have been a thriving industry at Huapu as in many other South Sea Islands.

At the upper end of this little community was a small Catholic church where a few of the inhabitants had gathered for the afternoon service; the greater number, however, had seated themselves in front of their houses or along the lane, to inspect us and give the Marquesan greeting, which sounded more like "co-ow" than anything else. As I neared the church the congregation was dispersing. One old man among the worshipers attracted my gaze, for he was heavily tattooed across the face. Next day I discovered this man busily engaged in making bowls of the tamanu wood, but when I asked him for carved bowls, he told me that only one man on the island did carving and that he lived in another valley, so I did not get a chance to obtain one of the rare pieces of artistic Marquesan handicraft.

The supercargo, having located a few tons of copra, decided to linger in port an additional day. Accordingly at daybreak on the following morning I again went on shore and made my way up a well-traveled trail toward the interior and to valleys farther up the coast. Family groups of warblers were flying from weeds and bushes into the guava trees, which bore ripening fruit. I had walked less than a mile when I saw the first parrakeet (*Coriphilus smaragdinus*) a beautiful little bird that is found only on this island, resembling in its restricted habitat the red-crowned dove, which is confined to Hivaoa, and the big blue-backed pigeon, which is peculiar to Nukuhiva. During the day I saw a number of the little pehites, as the parrakeets are called locally, and watched with great interest their aërial evolutions, in which they vied with their neighbors, the sea-going fairy terns, circling in the fresh wind over the mountain ridges and flying upward in wide circles until they had reached an altitude high enough to enable them to clear the peaks in their sweeps from one cañon to another. It was usually single birds that disported themselves in this way. Companies of four or five individuals, on the other hand, kept close to the forest trees, finding their food amid the ripening berries or else in the blossoming flowers that gave color to the cañon sides.

In the bottom of one cañon, where flowed a small stream, I met a native carrying a bunch of bananas, who pleasantly said "co-ow" as I passed. Four hours later on my return, I was surprised to find him only a few feet away from the same spot, though he had in the meantime picked another small bunch of bananas, and his wife, who was with him, had gathered a bunch of green leaves to be used in wrapping up poipoi on the morrow. When I stopped a short distance up the trail to listen to a bird's song, the couple passed me on their homeward way, the woman carrying the two bunches of bananas on a pole, while the man, smoking his pipe, tramped on ahead with the bundle of green leaves under his arm.

At one place in the thick forest I came across several of the old stone platforms on which former generations of Marquesans had built their homes, and in tramping around in other islands of the group, I frequently saw similar building sites or old stone fences that in the course of time had been covered with forest growth.

When I returned at four o'clock, the last load of copra was going aboard and shortly afterward we sailed for Nukuhiva again, to take on additional cargo. Reaching the cliff-bound southern coast at nine o'clock on a rainy night, the captain mistook the entrance to his bay and sailed five miles to the westward of it before discovering the mistake. Putting out to sea again with furled sails, he employed the motor to work up along the dangerous coast to the proper anchorage.

Next morning I carried my birds ashore and skinned them on the porch of Doctor Brown's house. The chief impression I have of the next two days is that of warding off nonos, which in spite of all my vigorous fanning inflicted many painful bites.

Sailing again at midnight, we entered Taipe Bay soon after sun-up, where the crew spent the day getting copra from the warehouse on the beach. Poles had been erected to hold the drying coconuts, and in addition defoliated trees were used for this purpose.

Several of the frame houses of this settlement were built on top of the ancient rock foundations used by the old-time Marquesans, and up the cañon a mile or more I found a couple of native huts erected on similar bases. It was, however, on the north side of the island, which we reached next day, that the best examples of the old rockwork were found. One of the sites visited had been used for religious purposes, and the carefully laid stonework extended for a hundred yards in one direction and for many yards in the other. Scattered around this structure were a number of well-built *paepae* on which had stood the dwellings of former generations of the fast-vanishing race.

Making poipoi, a dish relished in Polynesia

On one of the piles of built-up bowlders had been erected a modern-looking house. In front of it was a platform for drying copra, and just before the door of the house a young man was diligently pounding a mass of poipoi made from taro roots. At his side was a huge bowl of brownish-colored poipoi made from the fermented breadfruit, which, before being used, had been allowed to lie in a hole underground for the usual number of months. I sampled both lots. Although the poipoi made from the taro roots was not unpleasant in taste, the peculiar flavor of the other stayed with me for a long time. Near the breadfruit groves I saw several pits filled with this fruit over which in turn had been placed a covering of leaves, and on top of the leaves a pile of rocks.

From the village on the north side of the island a trail led back over the ridge into the head of the Taipe Valley on the south. I climbed up two thousand feet or so and looked across the rugged Taipe Cañon to a beautiful waterfall directly opposite the pass through which the trail led. The higher parts of the island seemed one succession of sharp ridges and narrow cañons, heavily forested and wrapped in clouds most of the time; as I looked back into the valley from which I had just climbed, the thousands of coconut trees around the head of the bay, with the dark upright masses of rocks on the west side, formed a picture that made me regret that I did not have a larger camera with which to register the beauty of the scene, my small pocket camera being inadequate for the purpose.

We spent three days in this locality, visiting a different bay each day and getting a few tons of copra from the shores of each. Working in the small warehouses, our crew filled sack after sack. Whenever a half dozen sacks were ready, the supercargo weighed them, using for the purpose a steelyard tied to a stick. The pole from which the apparatus was suspended was carried during the operation of weighing upon the shoulders of a couple of stalwart sailors.

On the shores of one of these bays I sat down under a forest tree to eat my lunch, but I found the nonos and mosquitos so ravenous that it was necessary for me to wave a small branch about my head continuously; however, when I was walking, they did not bother me. Wild chickens, pigs, and goats were abundant in this part of the island, and the engineer shot some chickens and goats, the pigs evading him.

Sooty terns (*Sterna fuliginosa*), which one sees almost daily in small numbers at sea when within three hundred miles of land, nest on many of the outlying islets that are striking features of the coast lines of the Marquesas, and when we sailed close by such an islet, a blast of the ship's siren would send a cloud of terns circling into the air. There are several of these bird rocks around Nukuhiva and some of them furnish the natives with a good many eggs and young birds during the nesting season.

When we left Nukuhiva, a course was set for Huahuna Island forty miles to the eastward. Here we entered a bay so narrow that there was barely room to turn the schooner. After the forward anchor and the kedge anchor astern had been lowered, a couple of lines were made fast to the rocks on one side of the cove and, though the captain found only three fathoms of water under the stern when he dropped the lead over, we remained safely at our moorings for a day, thanks to these precautions, getting a little copra, three horses, some pigs, sheep, and chickens.

Perhaps the most perfect example of tattooing—a practice formerly common but eschewed by the rising generation—was seen at this place. One old man, clad in a pareu, had his entire body covered with the artistic designs that will soon be seen no more on living flesh. To get a picture of him I had to bribe him with a present of five francs, but the resulting photograph did not show the intricate markings of the needle. Another old man had a strip of tattooing across his face, and I had seen an old woman at Hivaoa whose legs were well marked with the blue ink of the tattooer. As the custom of tattooing ceased about thirty years ago, it will soon be necessary to refer to anthropological books for a record of the designs used.

The horses of this island were notably better looking than those seen elsewhere, and the cowboy saddle of the western United States seemed to be in greater favor than any other style. Attached to one house was a pen in which were a dozen goats and a couple of cows; pigs were running unrestrained about the village and back and forth up the cañon; half a dozen saddled horses were standing in the stony lane that served as the main street.

I had only four hours ashore Monday morning in which to collect. I found the flycatchers (*Pomarea nigra*), which were commoner on this island than on any other previously visited, ranging over the hillsides and on the ridges in a manner quite different from that of the birds of Hivaoa, Huapu, or Tahiti, which keep to the dense thickets in the bottoms of cañons. As we hoisted anchor, I saw a flock of seven curlews (*Numenius tahitiensis*)—something I had not witnessed since visiting Christmas Island a few hundred miles to the northward.[1]

Due to favorable weather conditions we reached Hivaoa the next morning at about nine and spent the remainder of the day ashore. I was out on deck at daylight as we approached the island, and the first birds I noted were a fairy tern (*Leucanous microrhynchus*) and a red-footed booby (*Sula piscator*), early precursors of birds to be seen later in the day. The spirelike peaks of Huapu Island to the northward jutted into the clouds, and the high central ridge on Hivaoa was overhung by a heavy fog.

As we neared the southeastern end of the island, birds appeared in greater numbers, the sooty terns flying higher than their congeners, the noddies. A white-breasted, black-necked plotus booby contrasted strongly with his grayish plumaged relatives of the red feet; five miles from land a flock of lesser noddies, duplicates in color of their larger kin, were seen hovering over a school of fish. High above them sailed the black-robed frigate bird, watching with eager eye for some tern or booby to capture a fish, whereupon this pirate of the air would swoop down to harry the captor until the latter unwillingly disgorged what it had won through its efforts. As we sailed along the southern shore, fairy terns, frequently in pairs, flew about, coming from all quarters and some of them heading landward to feed their young, which were secreted in *Pandanus* trees high up on the mountain-side. Running closely along the shore to avoid the strong wind and current, we sighted a dozen wild goats, startled by the hallooing of the crew, who stood at the rail and lined the bowsprit as we rounded Point Teaehoa and brought into view the custom house on the beach at Atuona. Soon we were anchored in a small harbor, a mile from the settlement. Here hundreds of coconut trees covered the hillsides and stretched away into the valley to the northward, through which flows a fine stream of fresh water.

A day's walk up the valley is an interesting event, as I discovered when I made the trip. After leaving the beach, the trail passes for more than a mile through a coconut grove and at one place on the route are mango and coffee trees, as well as a grove of bananas, all bearing at this time their various products. Farther up the narrowing cañon, after the stream forked, I entered a vanilla plantation. The thick vines, bushes, and tangle of trees had been cleared from the rocky bed and small posts had been erected, up which the vanilla plants had climbed with astonishing rapidity. As there are no native insects that fertilize the flowers of the vanilla plant, the owner of the plantation has to go through it every day in the flowering season and with a small pointed stick take a little pollen from the upper part of the flower and introduce it into a tiny cup of the same flower lower down. One might think this a laborious task, but an expert can apply the pollen in a second or two and only a limited number of the flowers on a plant are treated.

Beyond the vanilla plantation a little-

[1]For an account of Mr. Beck's visit to Christmas Island, the reader is referred to NATURAL HISTORY, July-August, 1921, pp. 398-407.

used trail was followed, past old stone fences and tumbling rock piles till the cañon narrowed to the width of the running water. At one place on the bowlder-strewn cañon side was a little rock-encircled pit in which breadfruit had formerly been buried, to be resurrected later and eaten. On the cliffs high above me, noddy and fairy terns sailed around and around, and a pair of tropic birds (*Phaëthon lepturus*) joined them for a few moments while I watched. Doves were cooing, and persistent calling on my part would usually bring one or more of the small flycatchers to chitter-chatter over my head in the buro trees. Orange and lemon trees with juicy fruit growing on the higher branches, as well as guava trees, which here in the cañon reached a height exceeding thirty feet, drew my attention more than once. I was interested to note later that growing on the plateau were other guava trees, which although only three feet in height, were already bearing fruit. Our time at Hivaoa was too short to enable me to cover the island properly, but I spent another day on the plateau, where, at the highest point visited, I found the beautifully colored, red-crowned doves (*Ptilopus tristrami*), and I returned at dark with specimens of this little-known species.

Our stay in the Marquesas was all too short to make more than a preliminary survey, but long enough to show us what was needed and what to do on a subsequent voyage.

A DESCENT INTO NAVAJO CAÑON

A trail in this region may be compared to a sinuous thread running from water hole to water hole, and strange may be the course it follows. Here the knife-like crest of a sand dune, two hundred fifty feet in height beneath the horsemen in the foreground, offered a means of descent from the rim of the cañon to the pool where the vanguard of the pack train may be seen between the two clumps of trees at the left center

AN UNEXPLORED AREA OF THE SOUTHWEST*

BY

EARL H. MORRIS

ALONG the boundary line between Arizona and Utah, within the mighty northward curving bow formed by the Colorado River and its largest eastern tributary, the San Juan, there lies a country of unusual charm to the lover of nature and to the archæologist. The region is a vast plateau furrowed by hundreds of miles of labyrinthian cañons at every turn of which the traveler may expect new and pleasing vistas to unfold before his eyes and will seldom be disappointed. The magnificent desolation which is the dominant tone of the scenery weaves round the wayfarer an enchantment which ever calls him back to tread again the old trails and make conquest of the new.

The spell fell heavily upon Mr. Charles L. Bernheimer, whose initial visit to the Rainbow Natural Bridge, the most striking geologic phenomenon of the region, was described in a previous number of NATURAL HISTORY. As a result Mr. Bernheimer organized a more extensive expedition for the summer of 1921, of which it was the writer's good fortune to be a member.

We left Flagstaff, Arizona, on the afternoon of June 26. The road led northward through a pine-clad valley among the San Francisco Peaks and thence down a long, gentle declivity to Tanner's Crossing on the Little Colorado. In front and to the right of us lay the edge of the Painted Desert, its basic shades of red and green merging so softly with the mellower tints that one could scarcely determine where earth left off and sky began. Beyond the river, which at this season was a bed of sand between vertical walls of stone, the road again led northward, now over a ragged, barren upland of variegated shales and sandstone, and down to the crossing of the Moencopi Wash, where the fields and orchards surrounding the westernmost village of the Hopi made a pleasing picture in their frame of mottled cliffs.

From the rim of the Moencopi the lines of Lombardy poplars bordering the streets of Tuba City shone bright above the sand dunes. Beneath these black-green sentinels, planted by pioneers whom the Mormon Church sent forth to reclaim the desert, and now sheltering the western agency of the Navajo, we paused at sundown. When the journey was resumed, darkness had fallen, blotting out the landscape, but the motor droned onward until half past one in the morning when it halted before the trading post of Wetherill and Colville at Kayenta, one hundred and sixty miles northeast of Flagstaff.

Usually a trading post is a tawdry place, an ugly accretionary growth fabricated of all sorts of material from sunflower stalks and mud to the boards from packing cases. Such a characterization, applicable to the generality of trading posts, does not fit Kayenta, for there is blue grass in front of the low stone buildings, the vine-hung walls of which show dimly through rows of elder trees. Within the living room of the residence Colonel Roosevelt and other men of distinction have sat and discussed with the courteous hosts the craft of the frontiersman and the lore of the aborigines, and departed enriched by the experience.

It was after mid-day on June 28 that our cavalcade left the Flagstaff-Kayenta road at Marsh Pass and turned westward into the mouth of Segi or Laguna Cañon. At half past nine we encamped for the night in a little, sage-grown opening among the scrub oak and aspens near the head of a side cañon that enters the Segi from the left. On the follow-

*A record of the Bernheimer Expedition of 1921.

Old Reliable.—The desert horse is surefooted beyond the ordinary conception and may be trusted to pick its way over any obstacle which a man can cross unaided by his hands

ing morning the imposing cliff dwelling known as Betatakin (Side Hill House) loomed high and clear above us, its hundred rooms receding tier after tier upon the shelving floor of an enormous concavity in the northern cliff. Betatakin is the second largest ruin in the Navajo National Monument. It has been excavated and skillfully repaired, and together with the many other ruins in the Segi and its branches may be considered the nucleus of an archæological area in importance second to none in the Southwest.

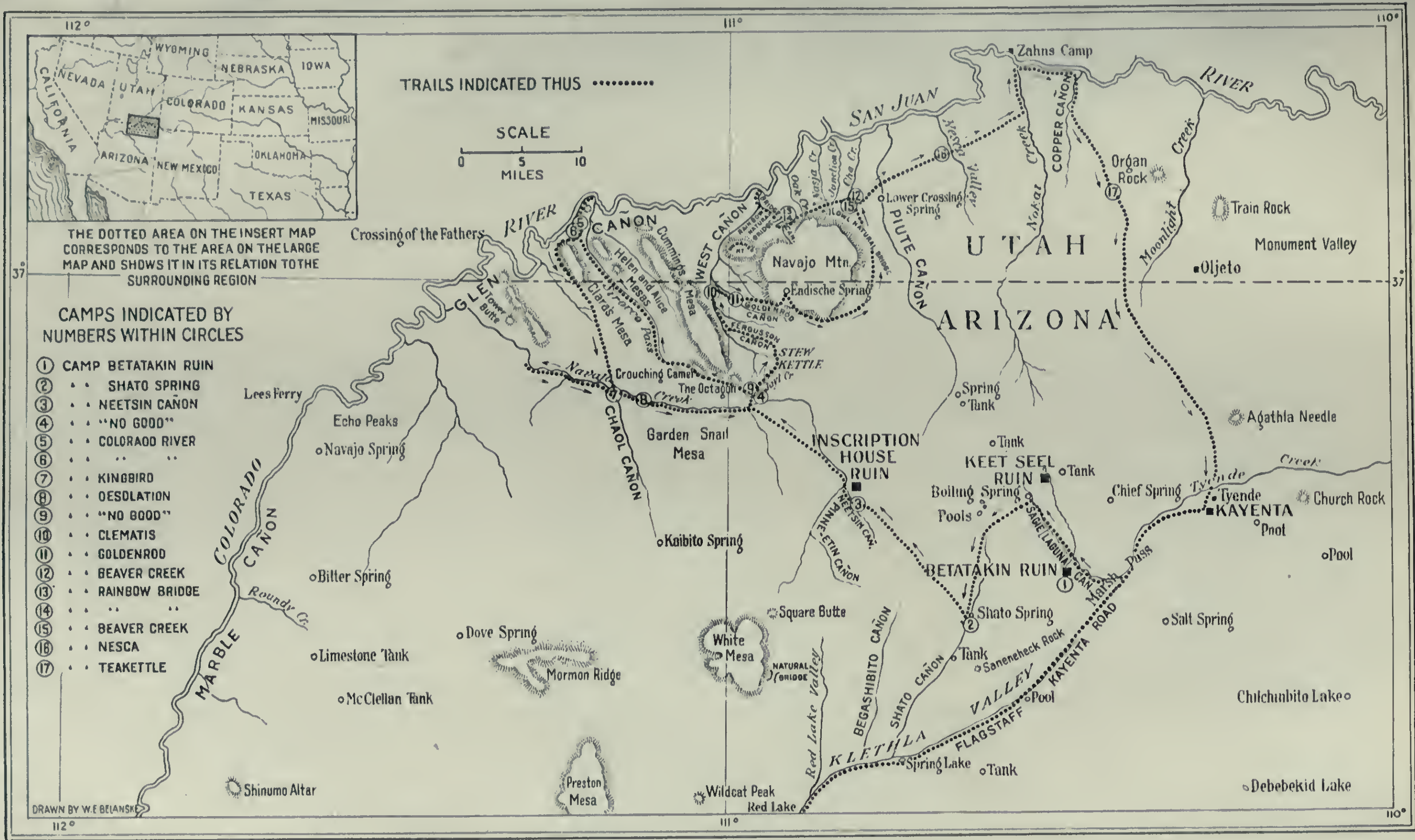
While we were examining and photographing Betatakin, a shout from down the cañon announced the arrival of an expected member of the party. The group was now complete and consisted of Mr. Bernheimer, John Wetherill, Ezekiel Johnson, Al Smith, Necloeybadani (The Laughing Man's Son-in-law), and the writer. Johnson, the new arrival, was to have joined us at Kayenta. When he failed to put in an appearance, we became apprehensive lest in coming across country from Blanding, Utah, he had been waylaid by the Piutes, who just then were in an ugly mood owing to the leaden vengeance which had been visited upon one of their number subsequent to thefts from the herds of the Mormons.

Freed of our anxiety, we were soon under way again, and the six riders and eleven pack animals wound in single file out of Betatakin Cañon and up the Segi. The trail was crooked and usually skirted the talus owing to the necessity of avoiding the arroyo and confluent washes, which have cut deep into the valley floor. A generation ago the bottom of the Segi was for miles a chainlike series of pools, hence the Spanish name, Laguna; but the only remaining traces of them are hardened bands of black muck in the arroyo banks and occasional patches of moribund reeds, the dwindling remnant of the greenery with which they were fringed.

After some miles the towering left wall of the cañon broke down into a series of ledges up which the trail zigzagged; from the rim rock the path led southwestward over a rolling mesa through forests of piñon and juniper interspersed with numerous sage-clad glades.

Noon of the next day found us beyond the divide which separates the drainage of the Little Colorado from that of its master stream, encamped beside a spring in Neetsin Cañon. Here because of the humidity from the spring, the heat was almost unendurable; yet the beauty of the greensward upon which the camp was spread, the clear streamlet which issued from beneath a ledge, and the line of Scottish thistles leaning forward from the rock on either side of it, each bright with purple bloom, soon banished thoughts of physical discomfort.

Inscription House, a large and important cliff dwelling which takes its name from an almost illegible inscription in Spanish, scratched on one of the walls in 1661, is situated in the lower reaches



ROUTE OF THE BERNHEIMER EXPEDITION, 1921

Drawings in white on the wall of Navajo Cañon.—There is no key to the meaning of these ancient rock markings. Conjecture is interesting but fruitless

of Neetsin Cañon. There we spent the afternoon photographing the ruin and collecting the beautiful fragments of pottery which litter the talus at the foot of the cliff. These fragments were the more durable portion of the refuse which the inhabitants of the cliff house tossed out of their front doors and over the brink of the ledge.

As we were returning to camp, there emerged from a crevice in the cliff what appeared to be a compact mass of foliage possessed of the power of locomotion. The suspicions of our mules were at once aroused, but we stayed their flight until the curious object came close enough for us to observe four hoofs beneath the waving greenery, and a dark head protruding from the top of it. It was merely a Navajo horseman returning homeward from some side cañon with half a wagon load of long, cottonwood branches—enough to roof a summer house—piled before and behind him across his mount.

There were two or three inhabited *hogans* in Navajo Cañon below the mouth of Neetsin. As we passed these on the following morning, the branches were being put in place on top of a scaffolding of poles. Acres of thriving young corn, watered by irrigation, surrounded the *hogans*, and westward of them stood a few large peach trees, gnarled veterans of many winters.

To avoid a long northward bend of the cañon we climbed out on the western side and were again on a rolling mesa. This stretch was a veritable desert. The entire foreground was composed of wavelike ridges and hummocks of windblown sand, while in the distance the buttes and towers along the Colorado River, dim and softened in outline, were visible through a sort of sunset haze. There were no trees except an occasional stunted piñon rooted in the crevices of a sandstone outcrop, but now and then we passed clumps of an evergreen shrub, which it was a pleasure to look upon. This bush, *Lepargyræa rotundifolia*,[1] resembling boxwood, grows always in dense, solitary clusters, sometimes six feet in height. The branches are thickly set with leathery leaves, which are slow to wither after they have been plucked. The silvery green foliage would make an excellent substitute for holly, and the shrub itself is easily worthy of a place in cultivated gardens.

Late in the afternoon we rode down the rib of a sand dune into Navajo Cañon about eighteen miles northwestward from Inscription House, at the mouth of Jayi Cañon, a northern tributary. In

[1]The only two specimens of this plant ever brought out of the desert and replanted are now growing in the New York Botanical Gardens, Bronx Park, to which they were presented by Mr. Charles L. Bernheimer.

A ledge trail in Bridge Cañon.—Where a V-shaped gorge in the cañon bottom makes travel there impossible, the path winds along a ribbon of talus between receding ledges

the angle of the watercourses, in both of which diminutive streams were flowing, there was a remnant of a level valley floor on which stood a *hogan* and a few peach trees. Two or three Indian families were encamped there with their flocks of sheep.

Wetherill had been as far as Jayi before, but the country lying westward and northwestward toward the Colorado River had not been penetrated by white men, unless perhaps by some fugitive from justice or misguided prospector who had failed to leave a record of the fact. Natsisan (Navajo Mountain), a powerful, thick-bodied Navajo, with little Oriental moustaches hanging from the extremities of his upper lip, had journeyed with us from the settlement at the mouth of Neetsin Cañon. Twice in his youth he had been to the great river (Colorado), and upon him we depended for knowledge of the trails. He said there were two: one, very rough, by which the distances could be covered in a day; the other, less difficult but much longer, would require at least two days. The shorter route was chosen.

All unnecessary impedimenta, including reserve supplies of food, corn for the animals, and most of our personal baggage was cached in a ravine at Jayi, and on the morning of July 2 we set out, this time with Natsisan riding in the lead. The trail ascended in a northwesterly direction to the foot of a knife-edged ridge hundreds of feet in height. The profile of this landmark suggested to Mr. Bernheimer the form of a crouching camel, and it was so named. At the head of the camel the trail seemed to end at the brink of a chaos of wind-furrowed

Clara's Mesa.—This impressive formation towers over a sea of oddly shaped bald rocks. A perfect replica of a Prussian spiked helmet may be seen in the dark cove on its westerly face

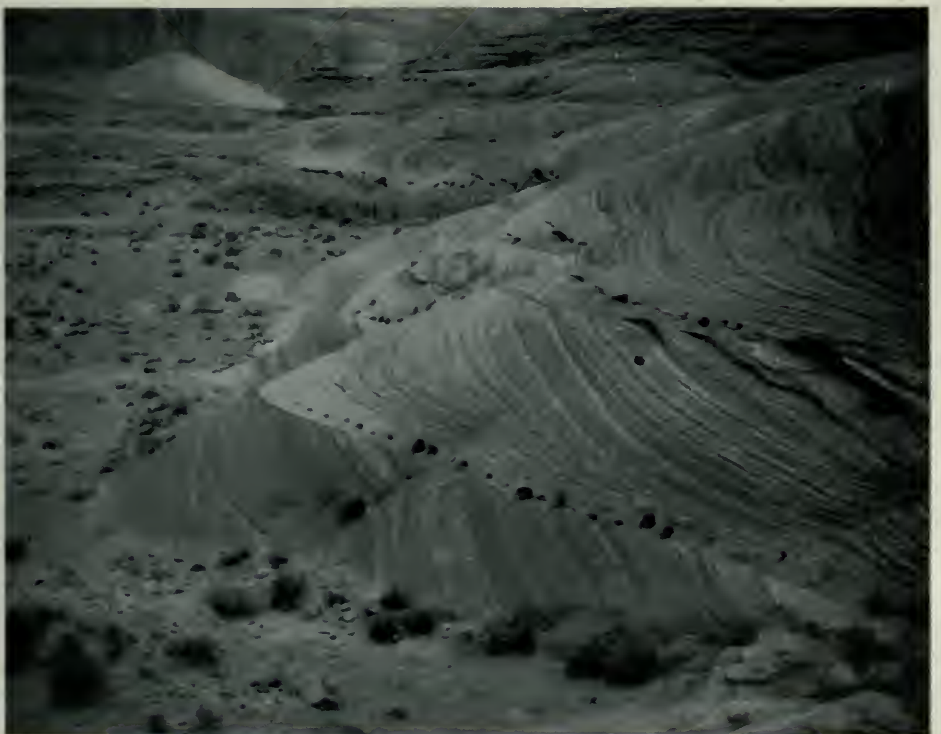
rocks so rough and precipitous that one would have judged it impossible for any creature larger than a chipmunk to climb down over them to the lower country beyond. The Indian was puzzled and appealed to Mr. Wetherill to find a continuation of the trail. The latter dismounted and, as if by instinct, led off around an abruptly sloping shoulder where the faintest suggestion of a ledge gave just room enough for the animals to place their feet. At this and a dozen other places passed in the descent, the consequences of a misstep on the part of man or beast were unpleasant to contemplate.

An hour later the hades of eolian erosion lay behind us, and the animals were munching the corn from their nose bags on a strip of sand beside a water pocket in the rocks. They were a motley lot, ranging in size from a misshapen, ragged-coated mule scarcely larger than a Shetland pony to Johnson's saddle animal, which had the proportions of a city draft horse. But each and every one was a veteran of the trail, sure-footed and dependable to the last degree,—qualifications which were essential and overshadowed all shortcomings of appearance and disposition.

The afternoon's ride was down the dry, sandy bottom of a valley which began at the "Crouching Camel" and ended at the Colorado River. All of the way a gale blew in our faces, at times so heavily laden with sharp, stinging sand that we rode with lowered heads, trusting to the animals to keep the proper course. That evening, in camp beside a willow thicket on the bank of the Colorado, Mr. Bernheimer, mindful of the wind storm, named the valley "Sirocco Pass."

We had come to the Colorado River primarily in search of a spot of unknown location, the Crossing of the Fathers, where in 1772, Escalante, while returning from his memorable journey of exploration from Santa Fe, in what is now New Mexico, to central Utah, had forded the dangerous stream and made his way thence to the Hopi towns. At the mouth of Sirocco Pass the course of the Colorado is nearly east and west. Between the water's edge and the south cliff there is a strip of level ground nearly a mile long and an average of one hundred yards in width. From the eastern

The eastern side of Cummings Mesa.—Cummings Mesa is a table-land nine miles long and six miles wide. A single precarious footpath gives access to the level summit, which was a refuge for the cliff dwellers in prehistoric times and for renegade Navajos in more recent years



Slick rocks on the east bank of the Colorado River.—These solidified sand dunes, resculptured by the agency which formed them, are a portion of the barrier between Sirocco Pass and the Cañon of the Colorado end of the flat there is a practicable route for a crossing, and also evidence of a trail leading up the northern cliff, hence the conclusion that our objective had been reached. Later, however, close questioning of Natsisan revealed that the object of our search lay some five miles farther down the river, where, as mentioned by Escalante, the water in pouring over a bar or reef is so shallow that, except in flood time, horses can ford without difficulty. Formerly the crossing was much used by the Navajo, who each winter drove off many horses, cattle, and even sheep from southern Utah with positive assurance that they were safe from reprisal once they had the spoils of their raids across the river. Eventually the Mormons, tried to the limit of their patience, brought down a few donkey loads of dynamite and blew out of existence the approach to the ford on the Utah side. It was so dire a calamity to the aspiring Indian herdsmen that news of it spread from one end of the reservation to the other in less than forty-eight hours.

The scenery along the Colorado was of a different character from that presented by the country to the southeastward, and evidently is the product of two cycles of erosion. During the first cycle the major portion of the original plateau was cut down about one thousand feet to a fairly uniform plane. The numerous isolated remnants of the plateau are sheer-walled, flat-topped buttes and mesas of vermilion-colored sandstone, usually capped with a greenish white band of harder, sedimentary material. Fully twenty of these buttes, distributed on both sides of the river, were visible from the mouth of Sirocco Pass. Because of their vast size, attractive coloring, and the singular beauty of their wind-sculptured walls, they are fully as magnificent as the better known monuments for which Monument Valley is famous.

At the base plane of the monuments degradation must have been negligible for a long period. Then the Colorado cut through some barrier to the southward and ground out a new cañon for itself, which process was taken up in lesser degree by the minor confluents. The ragged, tortuous cañons—such as the one traversed by Sirocco Pass—are the results of this second cycle. The primary mouth of the latter is fully a mile wide and well back from the river, whereas the present mouth is a vertical slot in the river wall not more than twenty-five feet in width.

We became attached to the level strip bordering the river at the mouth of Sirocco Pass because of the interesting things which were observed there. As we were examining a very old trail which led down the cliff to the western end of the flat, a black-tail doe sprang out of the rabbit brush below us and scurried away toward the other extremity of the level land. When we had tracked her eastward as far as she could go, she darted past us again, and in a willow thicket where the river met the cliff we found her two spotted fawns. These three deer were the only ones which Mr. Wetherill had seen in the Navajo country in all the years of his experience. Evidently the doe swam the river from the northward side in the spring before the fawns were born, and finding herself in a place where feed was plentiful, chose to remain there indefinitely. At no stage of the journey were forms of reptile life numerous, yet not far from where the doe was first seen there darted from the underbrush a lizard which evaded all our attempts to capture it. It was a brownish creature more than a foot long, with a fairly thick body and a broad tail adorned on each side with a longitudinal row of scarlet dots. This species, whatever it may have been, was new both to Mr. Wetherill and to the writer.

The night of July 4 found us for a third time in Navajo Cañon, but on this occasion at the mouth of Chaol Cañon, a southern branch which heads near Kaibito Springs. This point later proved to

Mr. Charles L. Bernheimer beneath an ancient piñon tree.—Here and there in the desert a piñon tree spreads its gnarled and distorted branches above a few square feet of sand, offering to the traveler a grateful respite from glaring sunlight and parching heat

be a day's ride westward from Jayi. The supply of grain for the animals was nearly exhausted, and in consequence, on the morning of the fifth the party was divided, Mr. Bernheimer, Mr. Wetherill, and the writer remaining behind to investigate the western portion of Navajo Cañon, the other members setting out for Jayi. Under the guidance of Dogistlanibega (Many Whiskers' Son) we rode westward to within ten miles of the Colorado River, where, in the northern cliff, there were two small ruins, the only ones which the Indian had observed below the mouth of Chaol Cañon. Most of the way the trail lay in the bed of the stream, which was by no means the impassable quagmire of quicksand that had halted all previous attempts to travel down the cañon. The Indian explained that five years previous to our visit a herd of cattle had wintered in the cañon, and that in wandering back and forth they had tramped and solidified the quicksand until it was no longer troublesome at any point between the mouth of Chaol Cañon and the river.

On the border of the stream, Dogistlanibega had two little cornfields and a few hills of melons, which he pointed out with great pride—a pride well justified in a year of such unusual drought. A flock of sheep and goats was being herded by three of his small children, who at our approach fled into the underbrush like rabbits. We commented upon the fact that the days must seem dull to these little folks, separated by many miles from all others of their kind, but before long we concluded that their ingenuity was equal to the circumstances and that they were not at a loss to find something with which to amuse themselves. There was a playhouse at the side of a large bowlder half buried in the sand. Four bits of driftwood, set up like posts,

NONAME MESA WITH NAVAJO

This view, taken between Goldenrod Cañon and Endische Spring, includes some of the roughest country to be found in the entire region

formed the outlines of an enclosure. Within it were a number of crude toy dishes of the children's own making, red like the earth of all this country: bowls, cups, tiny pots, one with three legs and a clay ball that filled it, and several cooky-shaped disks of clay.

That part of Navajo Cañon between the Kaibito branch and Jayi proved to be the most desolate stretch that we encountered anywhere. The torrents of recent years had swept away nearly all of the soil, which previously supported groves of cottonwoods and willows, the white, barkless trunks and branches of which were strewn about among the bowlders like dismembered skeletons. Our camp the night of July 5 was upon a dried mud flat where there was not a spear of grass for the animals and only chocolate-colored water to drink. The western species of *Datura* was the only conspicuous growing thing to be seen anywhere. The great, solitary, blue-green plants, laden with immense, trumpet-shaped flowers of waxy whiteness, presented an impressive contrast to the naked stones about them.

Our party reunited, we headed northward from Jayi on the morning of the seventh. Beyond the eastern end of the high ridge of which the Crouching Camel was the crest, lay a vast depression which we named the "Stew Kettle." It was a maze of tortuous cañons winding in and out among dumpling-like knobs of rock, too hopelessly rough to be crossed by a pack train. Veering westward we found the head of Fergusson Cañon, followed that to its junction with West Cañon, and journeyed down the latter until falls in the watercourse and sheer cliffs on either side put an end to our hopes of continuing northward to the Colorado. An adequate conception of the ruggedness of this particular region cannot be conveyed in words. About 85 per cent of it is bare rock. Less than half a mile west of our night station in West Cañon, which we named "Clema-

MOUNTAIN AT THE RIGHT

The panorama does not reveal the presence of three major cañons which lie five hundred feet beneath what appears to be the base plane of the foreground

tis Camp," Cummings Mesa—a long, narrow remnant of the original plateau—towered to a height of fully 1500 feet. Not more than ten miles to the eastward lay the pine-clad crest of Navajo Mountain at an elevation of 10,416 feet, probably 6000 feet above Clematis Camp. In looking from the foot of Cummings Mesa toward Navajo Mountain, the foreground might be likened to a sea driven in the teeth of a hurricane, the waves of which at their height had been transfixed to salmon-colored stone.

We had failed in our attempt to find a second route to the Rainbow Bridge by following West Cañon around the end of Navajo Mountain. Inasmuch as we were going to the bridge, there was no alternative but to strike eastward until we intersected the known trail.

On July 8 we netted only three miles. At sundown we were in an eastern bi-furcation of West Cañon to which the name of "Goldenrod Cañon" was given. This soil-floored furrow in the rocks was perhaps three or four miles long, and at no point more than seventy-five yards in width, a diminutive bit of the great wilderness but as beautiful as it was small. Groves of cottonwood darkened the shadows cast by the cliffs, and the grasses brushed the horses' bellies as they grazed. Luxuriant growths of goldenrod thrust their gaudy heads above the meadows, clematis vines draped fallen tree trunks in robes of downy white, giant *Datura* towered above the greenery around them, and lesser flowers, pink, blue, and violet, were visible among the grasses as these parted before one's feet.

These conditions were a sample of the past which had survived into the present, and in them lay the answer to a question which has perplexed many an observer. In Goldenrod Cañon and a thousand other cañons in the Southwest remains of the homes and handiwork of prehistoric agriculturists are much in evidence. It is plain that once fields of corn and beans and squash flourished where now there

Crossing the slick rocks.—These expanses of bare, wind-swept sandstone lie between Surprise Valley and Bridge Cañon. Only an experienced tracker can follow the Wetherill trail across them

is no soil at all, or what remains is as guiltless of vegetation as a city street. Here was Goldenrod Cañon, a natural garden, and just across the ridge, Navajo Cañon, desolation incarnate. As they were side by side, climatic changes and fluctuations in rainfall could not be called upon to explain the difference between them. Horses, sheep, and cattle had seldom ranged into the rough country as far as Goldenrod Cañon, while the upper reaches of Navajo Cañon had for generations been a grazing ground for the flocks and herds of the Indians. The prehistoric aborigines had no domesticated browsing animals. In their time the vegetation matured, died, and accumulated where it grew, forming a net which caught and spread the run-off from the showers over all nearly level stretches, whether portions of mesa top or valley floor. The moisture thus retarded soaked in and was retained by the soil. Within the past century the ranges were all overstocked. The protective coating was removed, the new grass was eaten before it could produce seed, and the tramping herds destroyed the sod, thus laying the soil bare before the onrush of water which followed each heavy rain. Cutting began and has continued to such an extent that the whole broad land is scarred and furrowed with numberless arroyos, each one a drain ditch as effec-

A difficult ledge among the slick rocks.—This is the most dangerous bit of trail on the way to the Rainbow Bridge and more than one animal has lost its footing and fallen to death in the chasm beneath tive as if designed by an engineer. The overstocking of the ranges and consequent formation of arroyos, rather than an absolute lack of moisture, may be held accountable for the barrenness of much of the Southwest today.

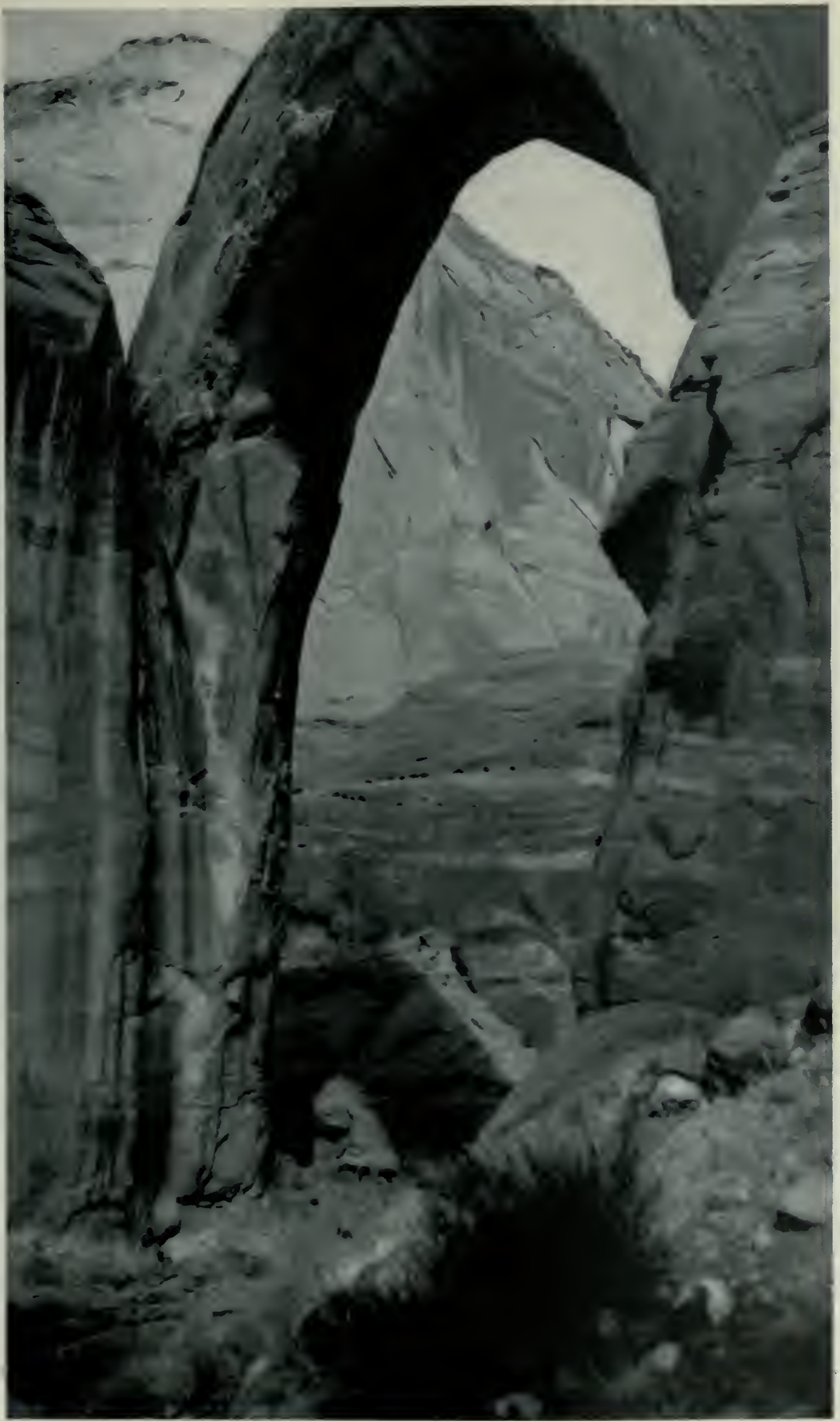
On the afternoon of the tenth the bridles were slipped from our tired mounts beneath the Rainbow Natural Bridge. The bridge is not more than six or eight miles in an air line from Clematis and Goldenrod camps, but to get there we had ridden fully fifty miles, and in so doing had made almost the complete circuit of Navajo Mountain.

Individual opinions, of course, might vary, but in the estimation of the writer there exists nowhere a more majestic and impressive natural object than the Rainbow Bridge. The name is confusing, for the strange product of erosion to which it is applied is in no sense a bridge, but an enormous arch with a span of 274 feet and a height of 308. The eastern end sweeps upward from an ancient valley floor, while the western extremity is buttressed by a shoulder of the cliff. So true are the proportions, so perfect the symmetry of the gigantic bow of stone that when gazing upward at it, one unconsciously bares one's head in reverence to the Master Architect whose handiwork it is. The fact that the aborigines shared this sentiment is evidenced by the ruins of two ancient altars in the shadow of the eastern base.

The Rainbow Bridge spans a cañon that carries the drainage from a part of Navajo Mountain northward to the Colorado River. The cañon is narrow, crooked, and in places from 800 to 1000 feet deep. The waters deepened their ragged groove through the soft, reddish sandstone of the plateau until a stratum of greater hardness was encountered. This stratum was slow to wear away, and its surface constituted the cañon floor for a very long time during which lateral erosion was, if anything, augmented. Where the bridge now stands, there was an abrupt horseshoe turn, the toe pointing toward the east. Indeed, the mechanism of the process by which the bridge was formed may be readily understood if the cañon at this point is vizualized as an enormous horseshoe of which the inner and outer edges of the metal are the cañon walls. The sand-laden flood waters dashed against the inner wall at the right side of the heel, were obliquely deflected toward the outer wall, swirled along it past the toe, and were hurled once more across the channel to strike against the inner wall at the left extremity of the heel. Thus the tongue of stone which filled the horseshoe was subjected to maximum abrasion where it was thinnest, that is, between the points of the heel. Eventually the impinging currents pierced the barrier between them, and thereafter the stream shortened its coarse by flowing through the breach of its own making, beneath the beginnings of the arch that millenniums later the Piute were to name The Rainbow.

The first white men to view the bridge were the members of a party headed by John Wetherill and Professor Byron Cummings, who reached the spot on July 5, 1909. To Mr. Wetherill is due the credit for the discovery, for it was he who learned of the natural marvel from the Piutes, and it was his skill which blazed a trail to it through a country so rugged that it would have discouraged anyone less experienced. Probably had the task remained for others to do, the Rainbow Bridge would have continued to be unknown for another generation or two.

Few of those who visit the bridge go on down the cañon to the Colorado River, thereby missing some of the most beautiful scenery the country has to offer. The trip can be made on horseback with no particular difficulty. In many places the reddish cliffs, streaked and mottled with darker stains, are so high that they seem almost to meet overhead. There are deep, clear pools in the stream bed, and cool springs well up through crevices



THE RAINBOW NATURAL BRIDGE AND ITS SHADOW

Imposing, tremendous, and perfectly symmetrical, the vast arch is equally impressive regardless of the angle from which it is seen

THE MOUTH OF BRIDGE CAÑON

Even at noonday the towering cliffs cast deep and somber shadows upon the pools and banded walls of this water-hewn gateway to the Colorado River in the rock. Some four miles below the bridge, Bridge Cañon empties into West Cañon through a slot so narrow that it resembles a gigantic doorway, whence even at midday one stares from twilight shadow into a dazzling glare of sunlight. The remaining two miles to the river consist of a succession of pools larger than those in Bridge Cañon. In many of these pools beaver dwell, and some of them the crafty animals have considerably enlarged by the construction of dams. In one of the ponds thus empounded there were catfish which in the clear water looked as black as lumps of coal. Two of the swart creatures were swimming round and round a clump of moss from which they seemed loath to depart. A poke with a stick sent swarms of inhabitants scurrying from the moss. They were tiny catfish, no longer than the first joint of one's finger. Can it be that some fish guard their young, or were the larger members of the tribe merely contemplating the toothsome meal promised by the younger fry?

There are several small cliff houses in West Cañon. In one, situated beneath an overhang where the clear streamlet loses itself among the turbid waters of the Colorado, there was a crude vessel fashioned from a piece of driftwood, and several names were written in charcoal upon the cliff. Some of the prospectors who are wont to ply along the river in the wintertime, washing gold from the gravel bars, had taken shelter in the ancient home of a people whose hearts knew not the lure of the yellow metal.

The Rainbow Bridge having been photographed from every possible angle, the final aim of the trip had been accomplished, and there remained but the journey homeward. On the night of the twelfth we camped for a second time on a ledge overlooking Beaver Creek. There was a threat of storm, but after a brief shower the black clouds rolled by and the morning dawned clear. The packs were nearly empty of food and grain, so some of the animals could be dispensed with. Those so footsore that they could scarcely travel were left behind to recuperate in a cliff-walled pocket where there were both grass and water.

From the northeast skirt of Navajo Mountain there are two trails to Kayenta. In order to avoid scenery that would have been an old story to several members of the party, we followed the arc rather than the chord of the bow. This led us northeastward over a less rugged country to the San Juan River at the mouth of Nokai Cañon, and thence east and south through Copper Cañon and the western edge of Monument Valley. In mid-afternoon of July 15 we wound past the gaunt spire of the Agathla Needle, and straightway the animals lengthened their stride on glimpsing familiar trails at the end of which they knew there would be at least a brief respite from the rigors of the march.

We had been out eighteen days without illness, accident, or disagreement; we had ridden on horseback fully four hundred miles, and had charted and named cañons, prehistoric ruins, and landmarks not indicated on existing maps; we had taken probably the most complete photographic record of the Rainbow Bridge which has been made up to the present, and from the crest of the Comb Ridge we were once more in sight of the elder trees at Kayenta.

THE HAUNT OF THE LYRE BIRD

The lyre bird (*Menura*), which derives its name from the lyre-shaped arrangement of the tail feathers of the male bird when spread in courtship, is partial to fern gullies. The present picture was taken in Victoria

The nest mound of the lowan (*Leipoa ocellata*) must be ranked among the greatest of ornithological marvels. The male as well as the female bird participates in the construction of the mound, which is usually about twelve feet in diameter and from two to four feet in height. In the egg chamber, which, it is said, attains a temperature of from 90° to 96° Fahrenheit, and hence is an ideal incubator, as many as three tiers of eggs are laid

AUSTRALIA'S WONDERFUL WILD LIFE

BY

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

OUR camp was pitched in a grove of gum tree (*Eucalyptus*) saplings, with a swamp almost at the "front door," and a vast tract of wild country stretching away to the north. While the "billy" boiled, my mates and I smoked and yarned, or paused to catch the cries of unseen birds —owls and "mopokes" (the Bushman's name for the frogmouth, *Podargus strigoides*).

At dawn we were waking, eager for our first excursion into the trackless country —the incult Mallee of northwestern Victoria. Mallee is the name for several species of small eucalypts, which form dense thickets, or grow in clumps amid shrubs and spinifex (*Triodia*) on sandy soil or good ground fit for agriculture. There are big sand ridges in the Mallee, crested with Murray pines, valuable as timber. All these lands were classed formerly as "desert," but vast areas have been reclaimed and, year after year, yield fine crops of wheat.

We had come to the wilds—the uncleared Mallee—to study and photograph birds; for the Mallee country is famous as the home of the lowan (*Leipoa ocellata*) and many other beautiful and interesting species.

As we entered the "desert," a lowan ran across our track in a leisurely way as if it were unafraid of man. But these birds, now becoming rare, are, as a rule, shy and wary, and usually only swift glimpses of them are obtained. Their flesh is good food, and some settlers,

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though the species is protected by the game laws, know well the taste of it. The fox, however—an alien from Europe, which is one of our worst pests now—kills many lowans or Mallee-hens, and robs their nest mounds.

"Thermometer bird" is one of the popular names for the lowan, the nesting habits of which are remarkable. Both the male and female birds are industrious, each pair constructing a huge mound of sandy soil and vegetable débris. The material often is brought from places some distance from the mound site. The birds scrape it along the ground with their powerful feet, and it is said that the wings also are used to aid in transport. The preliminary work (even if an old mound is renovated) is done in the autumn, and the mound is left open. Before the time of winter rains, the lowans scrape débris into the hollow of the cone, and cease work, perhaps for several months, until the heap of material has become sodden; a layer of sand is then added. Another period of waiting ensues; but at length the hotbed is ready and the egg-laying begins.

The eggs, which are much larger than those of a turkey and of a delicate pinkish brown color, are deposited in tiers, in a vertical position. They are enveloped in sand, a stratum of which protects each tier. The egg chamber is one of nature's incubators, "invented" ages before man learned how to hatch eggs by artificial means. In the hotbed a temperature of from 90 to 96 degrees Fahrenheit is generated. The parents escape the dreary task of brooding, but they visit their mound at intervals and work at it in order to prevent consolidation, and to make it easy for the chicks hatched from eggs of the lower tiers to reach the surface and escape from darkness into the light.

The lowan, which is also called "native pheasant," is rather like a young turkey, but more graceful and with some claims to beauty. Its color scheme is fawn, gray, black, and brown; the wings and back are spotted with white. The food of the lowan consists chiefly of seeds and ants, which abound in its haunts.

I have seen many mounds of the lowan, but during the trip I am describing I had little luck in finding them. It was disappointing. Still, we had no reason for complaint when we reviewed our experiences on the last day. On the banks of a little lake, calm and blue as a summer sky, we saw scores of the splendid "smoker," or black-tailed parrot (*Polytelis melanura*), and discovered the nests of this bird in hollows. This lonely place, in fact, was the headquarters of the species, which is protected because of its rarity. The male is a glorious bird, with greenish yellow head and neck, and the shoulders and under parts yellow. Flying in the sunshine, it is like a long flake of gold, tipped with shining black—the tail feathers. The female is not so brightly colored.

The "smokers'" nurseries were in hollows in gum tree boles, or big spouted limbs, from fifteen feet to forty feet above the ground. We saw birds leave home in a hurry as we passed close to their respective trees. The eucalypts, old and gray and gnarled, were rich in hollows, and nearly every one had feathered tenants. Not all of these cavities were occupied by "smokers." There were happy families of ring-neck parrots (*Barnardius barnardi*), dressed in bright green, with a yellow band on the hind neck; little hollows were tenanted by musk lorikeets (*Glossopsitta concinna*) green of plumage, with splashes of red behind the ears; while white cockatoos (*Cacatua galerita*) and pink cockatoos (*Cacatua leadbeateri*) were also rearing broods.

Our advent caused a great stir in this bit of birdland. The parrots protested, and cockatoos screeched defiance and anger, wheeling over the trees with their crests erected. There is, perhaps, no noisier bird in the world than the white cockatoo—its notes seem to rend the air,

A young pink cockatoo (*Cacatua leadbeateri*) voicing its demands

Still I, for one, like to hear them, because of their wildness. There is little danger of this species becoming rare, but its cousin (*Cacatua leadbeateri*) is not so fortunately situated. In its plumage this bird displays delicate salmon pink and white; the crest is crimson, white, and yellow. Prized as a pet, the pink cockatoo becomes too often a victim of the trapper. In the fledgling stage, both cockatoos and parrots are taken from their homes in hollows, conveyed to towns and cities, and hawked in the streets. They find a ready sale at prices ranging from about a dollar upward, and large numbers have been despatched overseas.

White cockatoos are no friends of the farmers, for they revel in a wheat field. Immense flocks are often seen, whitening the ground like a fall of snow, or perched in trees. They post sentinels, it is said—

birds that keep watch from lofty boughs and utter a shrill cry of warning at the least sign of danger, whereupon the whole flock takes wing.

In the Mallee we saw only small groups of cockatoos. Splendid they looked in flight, like big snowflakes against the blue of a cloudless sky. Sunshine and sky color, I hold, are used by nature cunningly to gain her finest effects with wild birds on the wing.

Of lesser birds the Mallee country has a rich variety. The wren warblers, with their long, up-tilted tails, are among the most beautiful. One species, *Malurus assimilis*, is purplish blue on the back; another is cobalt blue with white wings. The blue wrens—there are many species—build domed grass nests close to the ground, and are favorite dupes of the shining bronze cuckoos. It is a strange fact that, although they resemble each other closely, one of the species of bronze cuckoos lays a bronze-green egg and another an egg that is white with pinkish red spots and similar to those of the wren warblers among which it is so often placed.

The Mallee has its own variety of emu wren (*Stipiturus malachurus mallee*), a brown, fairy-like bird, with a patch of sky-blue on the throat, and a marvelous fan of tail feathers loosely webbed and carried erect in miniature emu plumes. These tiny birds creep through the undergrowth, or make quick, darting flights, low over the bushes.

We heard, close to our camp, the notes of the crested bell bird (*Oreoïca cristata*), a clever ventriloquist, which sometimes fools a stockman seeking horses. I have been fooled myself by a bell bird, thinking it many yards away, when it was calling from a bough close by. The notes are clear and musical; but, as a songster, the ventriloquist cannot rival the whistlers (*Pachycephala*), which, indeed, are master minstrels. If I were asked to select a team of Australian birds to sing against the famous songsters of

A nesting haunt of cockatoos and parrots in New South Wales

Europe or America, my choice would be the rufous-breasted whistler (*Pachycephala rufiventris*), the lyre bird (*Menura superba*), the magpie or piping crow shrike (*Gymnorhina leuconota*), and one of the fly eaters (*Gerygone sp.*).

The lyre bird, which takes high rank as a mimic, haunts fern gullies in ranges that lie far from the Mallee country, and many happy days have I spent in its haunts. pearled moss, starred with brilliant fungi, crimson and yellow and purple-red—while picking my way through a tangle of logs and creepers to the edge of the little creek, which sang a ripple song across the pebbles. It was pleasant to ramble among the tree ferns, the noble fronds of which, like giant umbrellas, shut out the sunlight. It was moist and green and silent in the haunt of the lyre bird.

The dancing mound of the lyre bird.—These mounds, a few inches in height, are made of light sand. The male bird struts about on them, raising and spreading his beautiful tail even though the admiring female is not always present to behold his antics

We have three species of *Menura*. All are superb voice artists, and notable for grace. I am most familiar with the Victoria lyre bird (*Menura victoriæ*), which is not uncommon within a score of miles of my suburban home. One day I went to the ranges with field glass and camera, to hunt for these birds. From a tree-bordered track I plunged into the heart of fernland, brushing raindrops from a hundred drooping fronds and stepping softly on the dead leaves of unnumbered years—deep mold covered with dew-

Presently, as I leaned lightly against the trunk of a tree fern, the silence was broken by shrill cries that echoed down the gully. A lyre bird chick, startled in its nursery, had given the signal of distress. The nest, a round mass of sticks and rootlets, larger than a prize watermelon, was wedged between two fern trunks just above my head. Usually *Menura* builds close to the ground, but in districts where foxes abound it has taken to nesting among the lofty boughs, to baffle the furred raiders.

The young bird's cries of fear and distress were quickly heeded. A female *Menura* came flying on to a branch close to the nest and above it, and regarded me with misgiving. When I climbed to the nest and thrust a hand into the interior, the baby bird screamed again; and when I descended to the ground, the mother bird took my place. She was suspicious but not really frightened. At least she remained at the nest, or near it, while I fixed the camera on a tripod, and focussed on her favorite perch. Three plates were exposed at close range; only dim light and flickering shadows spoiled a chance of securing perfect pictures.

Later, when lunching by the creekside, I heard a male lyre bird give his own call, and then proceed to imitate the calls and songs of many other species. He mimicked a flock of parrots, as they call when on the wing, the strange notes of the coachwhip bird (*Psophodes crepitans*), and a score of other familiar voices of the bush. And when he had gone through his repertoire, he began again and repeated the performance with variations. Some Australian naturalists claim supremacy for the lyre bird as a musical mimic. He is wonderful; but I have not heard the mocking bird of America, and shall not venture on comparisons.

On hill slopes in the ranges I discovered several small circular clearings, slightly raised, and with the earth "worked over." These were dancing mounds. Male lyre birds are, perhaps, not accomplished dancers, but they seem to find pleasure in strutting about and capering on the mounds that they make. One bird may use four or five mounds. These displays *may* please the females, but often they are given without spectators.

Where *Menura* is, you will hear or see the pilot bird (*Pycnoptilus floccosus*), a small, dark brown species which appears to be as fond of the lyre bird's company as the pilot fish is of that of the shark. It is likely that "cupboard love" is the reason for this companionship. Pilot birds pick up "crumbs" from their big friends' table, as it were, gleaning in the wake of the hunter as it scratches over the moss and tears decayed logs to fragments. "Guinea-a-week," are words that the *Pycnoptilus* seems to call as it forages.

In the gullies, too, I heard the coachwhip bird, but rarely saw it, for it keeps under cover. A sprightly black bird, crested, and with white cheek patches, it builds a saucer-shaped nest of rootlets, placed at no great height in a tangle of wire grass or creepers. The eggs (two to a clutch) are beautiful—blue with sepia or black markings, like hieroglyphics or Arabic characters.

In the ranges I had an old bark hut, named "Walden," after the slab dwelling near Concord, where Thoreau observed wild nature's ways. My "Walden Hut" stood in an untended garden, with a bush track as one boundary and a creek for another. Here, with two brother naturalists, I spent week-ends and holidays, year after year, until war broke the sequence. We wandered all over the district and gathered a rich harvest of field notes and photographs.

At night, sitting quietly in front of the shack, often we witnessed the aërial skill of flying phalangers (*Petauroides volans*), or "squirrels," as they are commonly called in Australia. Creeping to the end of a dead gum-tree bough, about sixty feet high, each little animal, black on the upper surface and white underneath, would crouch and then leap into space, with the loose skin along either side of the body expanded. The "flight" was a gliding dive, ending on the trunk of a tree some distance from the "leaping-off place." Just before the end of its journey through the air, the "squirrel" would turn upward, as a man does after a dive in the sea, and alight on the tree bole neatly. Then up it would climb, perhaps to repeat the performace.

The lesser flying phalanger (*Petauroides breviceps*) was much rarer in our district (about thirty miles from Melbourne, the capital of Victoria) than the big species. One we captured, and it became a charming pet, bright-eyed, soft-furred, and graceful in all its ways. It soon lost its fear and acquired a taste for sweetened milk and biscuits. It would "fly" from the back of a high chair on to a window ledge, and would sometimes alight, softly as thistledown, on its master's shoulder.

We made excursions far and near, but wild life near the hut never failed to repay attention. Blue wrens nested in the ivy; swallows under the back eaves; and other small birds in the garden or down by the creek. A list of species would be wearisome; yet I must mention our friends the kookaburras (*Dacelo gigas*), which nested in a hollow, high up in the trunk of a gum tree growing near Walden Hut. They reared two fledglings one season, near the end of summer. We enjoyed every day the gurgling, laughing notes of a quartette of these great brown kingfishers or "laughing Jacks," as most people call the kookaburras.

The coachwhip bird (*Psophodes*) which dwells in fern gullies and rarely appears in the open, derives its name from the terminal note of its vigorous song, which is clear and sharp as the crack of a coachman's whip. The nest is often placed in a low bush screened by thick underbrush. The eggs are among the most beautiful: sky-blue with curious black markings

A young kookaburra (*Dacelo gigas*).—The eggs, a beautiful pearl-white, are frequently laid in a hole in a gum tree, the decomposed wood at the base making a soft bedding for the nestlings. Rather devoid of shyness, even inquisitive, the kookaburra is an engaging bird, with which one is glad to make friends

The "opossums" of Australia are, of course, not entitled to the name; they differ, both in structure and habits, from the American opossum. Around the hut ring-tailed phalangers (*Pseudochirus peregrinus*) were plentiful. In our rambles we came upon their big round nests—built among branches a dozen feet or more from the ground.

The *Pseudochirus peregrinus* we saw, but not the species that every Australian zoölogist longs to behold. Leadbeater's opossum (*Gymnobelideus leadbeateri*) is, in fact, the rarest of all the marsupials if, indeed, it be not extinct. Less than six specimens have been obtained—all from a small area on the Bass River, Victoria. The habitat has been searched again and again, yet not a glimpse of the animal has rewarded the seekers. I shall go to Bass River myself very soon—not to collect, but to see and photograph the

A young ring-tailed phalanger, one of the interesting Australian marsupials

Nest, in an *Acacia* tree, of the ring-tailed phalanger (*Pseudochirus peregrinus*) commonly called an "opossum."—These marsupials are found in abundance in southern Australia and are very popular as pets. They build nests about the size of a football, of fern fronds, dead leaves, and other materials

haunts of a beautiful creature which doubtless has gone from the world forever.

Our creek at Walden was fringed with wattles (*Acacia*), which dusted the water with gold in springtime and sheltered a thousand wild birds. Here the gray thrush (*Colluricincla harmonica*) sang at dawn and after, the name of an American bird, bobwhite, sounding in its song —"bob, bob, bob whit-e." Here there were honey eaters, golden tufted and olive green, and shrike robins (*Eopsaltria australis*) with yellow breasts.

The fact that there was a stream suggested the possible presence of the platy-

AN AUSTRALIAN "TEDDY BEAR" AND ITS CUB

Although called the native bear, there is a vast gulf between this animal, the koala (*Phascolarctus*), and bears as we know them in other parts of the world. The koala is a marsupial and such resemblance as it has to the true bear is merely superficial pus, or duckbill; but, though we went quietly at twilight, we did not see one in our creek. Farther afield, fortune was kinder. After sundown, in an upper reach of the Yarra River, glimpses of the platypus were won. We never saw one ashore, though the duckbill does make little land journeys, crawling awkwardly. Like penguins these paradoxical creatures are clumsy out of their element; but in it, swift and graceful.

Occasionally the platypus is found in the net of a river fisherman. It is rarely seen, except by those who know its ways and observe a studied quiet. A lover of shadows, the duckbill avoids sunlit reaches on its home stream. To see it you should be by creek or river when the day is young or at sunset, for these are its hours for feeding.

In the last few years our knowledge of the duckbill's habits, of its domestic life, has been increased by studies in the field. Mr. Harry Burrell, of Sydney, New South Wales, has watched the animals at work and at play; he has explored their long burrows and has collected specimens in all stages. In brief, he has gathered material for a full dress biography of *Ornithorhynchus anatinus*.

I have chosen and pieced together stray notes from the book of my wanderings in Australian wilds—the book of golden memories, which gains fresh pages every year. A month ago I was camped on a lake with subtropical scrubs along the shore. From my tent, a stone's throw from the jungle, every day after sunrise I saw full-plumaged males of the regent bower bird (*Sericulus chrysocephalus*). Splendid in orange-gold and black, they came from a tall tree into the open to feed on inkweed berries.

In the morning chorus I distinguished the call of the cat bird (*Ailurœdus smithii*), another member of the bower bird family. Its notes, like the mewing of a cat, earned the bird its trivial name.

I went south to Sydney, where a day of rare luck in the National Park gave me records of another species of brown bird. The park is a pleasure resort for the people of a great city, yet it contains thousands of wild birds that rear their broods in safety within sound of human

(Above) The echidna (*Echidna aculeata*) burrowing.—This animal is a strong and speedy digger. Disturbed, where it has no chance to go underground quickly, it rolls itself into a ball, head and legs tucked in, and thus often escapes harm

(Below) The echidna ready for the enemy. —The echidna is not inappropriately known as the Australian hedgehog or Australian porcupine

laughter and song. The picnickers do not disturb them. Lyre birds run across the roadway, and close to the Rest House you may find the playground of the satin bower bird.

One male of *Ptilonorhynchus holosericeus* has a wonderful bower, within six

A STRUCTURE OF THE SATIN BOWER BIRD

The bower, or playing place, constructed by this bird, is frequently ornamented with gaily colored or shiny objects that this bird has pilfered,—the blue tail feathers of certain parrakeets, bleached bones, the shells of snails, pebbles, berries, bits of china, broken glass, and the like, being among the odds and ends enumerated by different authors feet of a road which, during the week-ends, is traversed by hundreds of motor cars. Concealed by a log, I watched the satin bird come to his play place. He entered the bower, removed a bit of orange peel, and had a general look around, unconscious that a nature lover was in hiding barely a yard away. Sunlight gleamed on his blue-black plumage, lustrous as satin, and on the beautiful blue eyes. A cough broke the spell and my bower bird flew off to join his mate in a tree across the highway. The female and immature males of this species are greenish gray, with crescent-shaped markings of dark brown on feathers of the under surface of the body. The males become "blue" birds when about seven years old.

When we spread a meal near its bower in the park, the friendly satin bird became a welcome guest. To encourage him we sat in a wide circle around the "board," a white cloth on the grass, and remained silent and still. For a while he gazed longingly, then dropped from his perch in a gum tree into the midst of plenty. He pecked at a ham sandwich, sampled the cake, and reflected. Another beakful of sandwich, then back among the boughs,—a pleasant incident for a naturalist to store in memory!

The black swan (*Chenopsis atrata*) is found in Tasmania as well as in Australia

WINDOWLESS MUSEUMS

BY

FREDERIC A. LUCAS*

LIGHT is the great enemy of natural history collections: the lovely Luna moth fades after a few days—almost after a few hours' exposure; birds lose their brilliancy and the feathers of humming birds actually seem to disintegrate on long exposure to light; a few years ruin mammals like deer and foxes, and such seemingly fast colors as black turn reddish. Some minerals even are affected by light, and Rose Quartz, instead of getting heightened color, pales in the sunshine and must be kept in the dark if her charming complexion is to be preserved indefinitely.

So the visitor to the mammal gallery of the British Museum of Natural History may find the shades drawn and labels calling attention to the fact that it is done to preserve the specimens, and in many continental museums the galleries are shrouded in darkness save for a few hours on stated occasions.

And yet light is necessary if visitors are to see and enjoy the exhibits of a museum; so museum authorities have been more and more perplexed as museums have become more and more popular, by the problem of having plenty of light and at the same time of preserving specimens for posterity.

The most harmful rays are the ultraviolet. Science has done so many wonderful things that it seemed within the range of her abilities to devise a light filter that should keep out the dangerous actinic rays while letting the others pass, and Sir William Crookes gave much time and thought to this problem.

Green or yellow glass, it was ascertained, acted as such a filter, but there was the objection that the light was not white, an objection which was answered at the Victoria and Albert Museum by using green and orange glass in such proportions that the result was a white light. When the exhibit of colonies of bacteria was installed in the department of public health, American Museum, some of them "broke down" after a short exposure to light, though that light came through heavily frosted glass. Pale yellow glass was then placed in front of the frosted glass and since that time none of the colonies have broken down.

Similarly, in the hall of North American mammals it was found that frosting the windows on the southern side did not suffice to cut out the glare of the winter sun and the lunettes were fitted with pale yellow "cathedral" glass, which seems both to cut out harmful rays and diffuse the light. That this light is not white seems a negligible consideration, the more so as in many of the groups shown in the Museum white light has been carefully avoided.

Frosted glass was used as the result of certain experiments made about ten years ago by Dr. R. W. Tower. By means of the spectroscope he showed that frosted glass cut out a goodly share of the ultra-violet rays, and that electric light, and especially that passing through frosted bulbs, was much less harmful than sunlight. The object of this experiment was, literally, to throw light on the question of the possible injury to specimens in "habitat groups" illuminated continuously by electric light, and on the still larger problem of what would be the effect of discarding daylight and relying solely on electricity for lighting museum buildings. Electric light has many advantages; it shines when and where it is wanted and—barring accidents—it shines at all times with the same degree of intensity.

About the same time Doctor Tower made his demonstration, Dr. S. F.

*Director of the American Museum

Harmer (now Sir Sidney), director of the British Museum of Natural History, began a series of experiments with a variety of objects submitted to light of various kinds, and the results of these experiments, carried on for about ten years, he has published in *The Museums Journal* (of Great Britain) for April, 1922. The last of these experiments was with a number of objects exposed continuously to different kinds of light for a period of 1030 days, nearly three years. They show conclusively that electric light is much less harmful than daylight, and Sir Sidney concludes his article with the sentence, "A gallery without windows, lighted entirely by electric light, preferably not arc lights, would have great advantages."

It is interesting to note that this series of experiments, carried on over a period of nearly ten years, corroborates the deductions made from Doctor Tower's observation with the spectroscope, but it is a little discouraging to find that, so far, a transparent, non-actinic glass—and Sir Sidney experimented with several kinds—is a failure. It would seem, therefore, that we must turn to electric light for help in our difficulties, and it is possible that these may be solved by its use, plus a ray filter.

There would be other advantages in the use of electric light, for it would mean among other things that all, or nearly all, wall space could be utilized, that there would be no dark corners in exhibition halls, and that summer and winter there would be the same degree of illumination. Modern improvements in lamps have made it possible to secure almost any quality of light up to pure white, and some of us may live to see the time when museums of natural history will be constructed without windows.

In this country the advocates of museums illuminated solely by electric light are Doctor Matthew and Doctor Stejneger. Doctor Matthew has figured that the gain in wall space from the omission of windows would offset the cost of the electric light. Some architects have begun to consider the problem. Mr. Carl E. Akeley and Mr. Alfred F. Rosenheim also have planned halls to be lighted with electric light only. While these were halls for "habitat groups," yet it is probable that they are the forerunners of the windowless museum.

In closing, it is of interest to quote the conclusions which Sir Sidney Harmer drew from one of his experiments:

(a) Darkness, even if accompanied by a considerable rise in temperature, is a complete protection to fugitive colours.

(b) Moisture in the air assists fading and is probably essential to it.

(c) The rays of the blue, violet and ultra-violet parts of the spectrum are particularly injurious, as shown by the marked superiority of glass 38 [a yellow-green glass, of decided colour] over the others used. These rays are not, however, the only ones to be feared, as in direct sunlight fugitive colours projected by this glass became practically bleached after a prolonged exposure.

(d) Other glasses, of less pronounced colour than 38, but agreeing with it in cutting off part of the violet end of the spectrum, afforded some protection, and in the initial stages of the experiment were always slightly superior to ordinary window-glass. The protection was only partial, having the effect of merely prolonging the period necessary for complete fading.

(e) Fading was found to take place much more quickly in fugitive artificial pigments than in natural objects, some of which showed no change at the end of the experiment, even if exposed to direct sunlight.

(f) Direct sunlight was much more injurious to colours than any other form of illumination used.

(g) Diffused daylight appeared to be on the whole slightly more injurious than any form of electric light.

(h) Of the electric lamps used, the Half-Watt gave the best results. The Arc-lamp was probably the most injurious, the equal amount of fading produced, in some cases, by the Filament-lamp having to be discounted by the fact that the latter was continuously alight and was placed much nearer the objects.

ALLEN HALL OF NORTH AMERICAN MAMMALS, AMERICAN MUSEUM

THE DEPARTMENT OF MAMMALS, AMERICAN MUSEUM

A HALF CENTURY OF ACHIEVEMENT

BY

H. E. ANTHONY*

IN THE early history of the American Museum, which began in 1869, with Professor A. S. Bickmore as the first head of the department of mammals, there was but the one department to cover both mammals and birds, as well as other branches of zoölogy, and the Museum was starting with empty exhibition halls and empty storage cases. The beginnings of the collection of mounted mammals go back to the purchase of the Maximilian collection, followed by the acquisition of collections made by Verreaux and Vedray. Magnificent as these were in their day, they have long since ceased to be an exhibition feature and now are interesting solely as historical specimens, while the general public has forgotten that they ever existed. The reason for this has been the great influx of material since that time and the marvelous strides made in the methods of preserving and exhibiting mammals. But back of this progress and directly responsible for it is the evolution and development of ideas.

Fifty years ago a museum was judged by different standards and few had guessed at the possibilities of natural science. The increase in the size and number of exhibition halls, the constantly rising standards of exhibition, the accumulation of many thousands of study specimens, and the volumes of research publications brought before the public, have followed inevitably as the result of the glimpsing of these possibilities and their exploitation by the naturalist.

Dr. Frank M. Chapman has clearly set forth the aims of a department of birds,[1] which may be summarized briefly as the ability to answer any inquiry concerning birds, their place in nature, and their relation to man. The department of mammals encounters very much the same kind of problems as does the department of birds and strives to present to the public the facts of its science through the same media, namely groups and exhibits, publications and lectures.

To the general public the most obvious function of a department of mammals is the planning of exhibition groups and the satisfaction of the usual normal curiosity of the layman, who wants to see in striking external characters the difference between the fox and the wolf, or the deer and the caribou. Consequently, this brief résumé of department history will be largely concerned with this phase of its development. However, so varied are the queries addressed to the department of mammals in a large museum and so diverse the demands made upon it that, ranging from the theoretical to the practical, it may be called upon to decide wagers as to whether the whale was physically able to swallow Jonah, or to give advice as to how disturbing colonies of bats may be driven out of church towers; while questions of significant economic importance include the relations of rodent pests to the farmer, carnivorous mammals to the stockman, and fur-bearing mammals to the world at large. Only by constantly delving for facts, by unremitting research, can the department fulfill the expectations of the public.

The first serious attempt at the inauguration of a department of mammalogy began with the curatorship of the late Dr. Joel Asaph Allen. He came to the American Museum in 1885, fresh

[1]NATURAL HISTORY, July-August, 1922, pp. 306-18.

*Associate Curator of Mammals of the Western Hemisphere [In Charge].

This view of the old North American mammal hall, taken from the *Daily Graphic*, New York, December 22, 1877, should be contrasted with that of the same hall—remodeled and lately re-christened Allen Hall of North American Mammals—as it appears to-day (see frontispiece of this article). From "stuffed" mammals, surrounded by benches, to modeled animals shown in their habitat is a great stride forward and measures the artistic development of taxidermy

from the Museum of Comparative Zoölogy at Cambridge, where he had been steeped in the lore of Louis Agassiz. Doctor Allen found no mammals in the study series and but a mere handful of mounted mammals in the exhibition series. With characteristic energy he set about the enlargement of both. At first he did all his own cataloguing and labeling, not only of the mammals but of the birds as well, for the two departments were not separated until 1920. From this small beginning the collections began to grow by leaps and bounds, and additional personnel, beginning with Dr. Frank M. Chapman, who joined Doctor Allen in 1888, came into the department.

Today the staff of the department of mammals consists of ten members. With the growth of the activities of the American Museum all over the globe, and the consequent accumulation of material, it was found advisable to divide the field covered by the department into two subdivisions, resulting in the present organization. In the table that follows, the date preceding the name of an individual signifies the year of his entering the department.

1906	Roy Chapman Andrews, associate curator of mammals of the Eastern Hemisphere.
1911	H. E. Anthony, associate curator of mammals of the Western Hemisphere.
1915	Herbert E. Lang, assistant curator, African mammals.
1921	Carl E. Akeley, associate in mammalogy.
1911	Miss Agnes F. Molloy, secretary.
1917	Miss Ruth D. Evans, secretary.
1919	Mrs. Helen Ziska, department artist.
1920	T. Donald Carter, department assistant, Eastern Hemisphere.
1920	George G. Goodwin, department assistant, Western Hemisphere.
1916	Arthur J. Dougherty, department assistant.

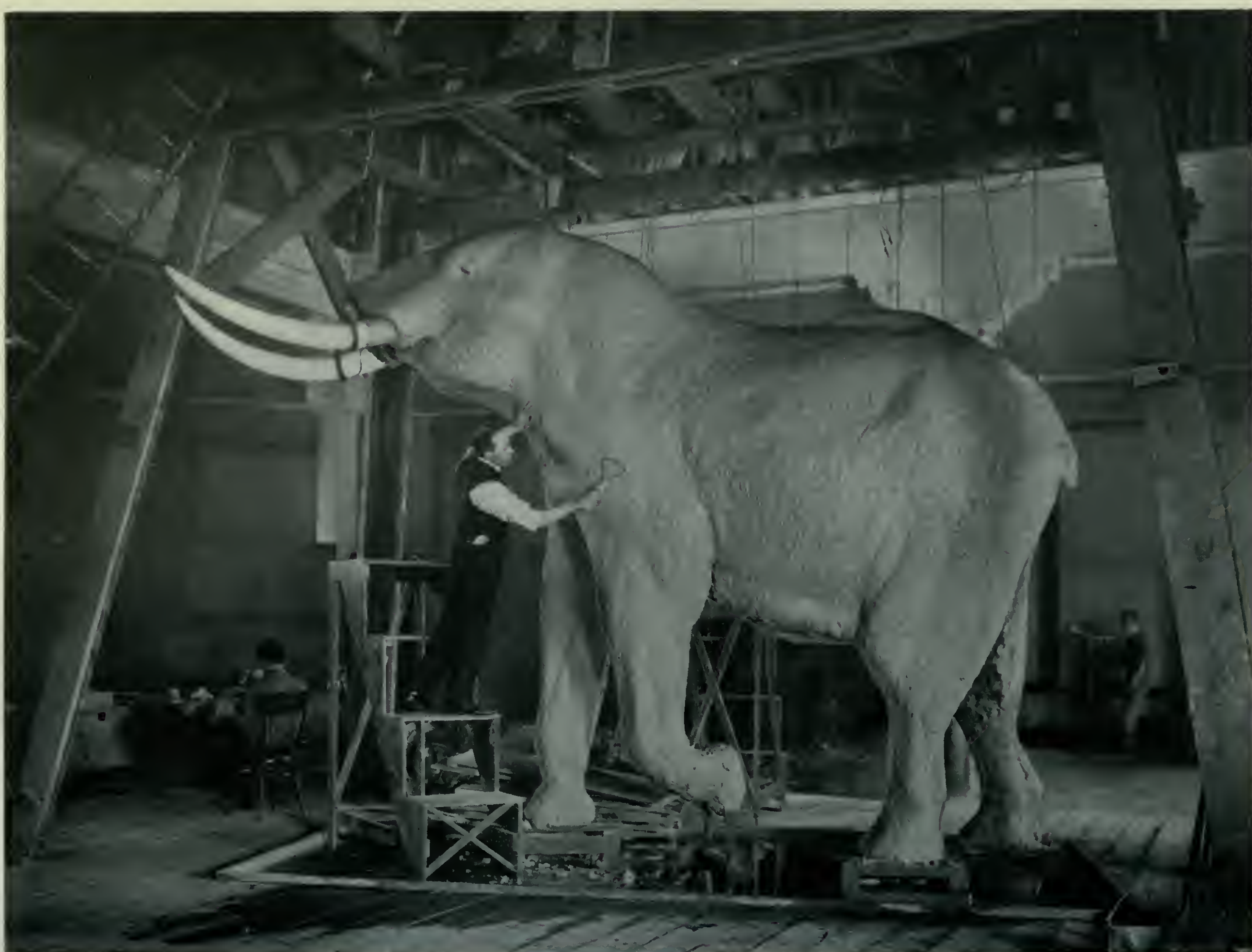
The two associate curators have full charge of the field work and research in their respective branches of study, and by a division of this nature there is less likelihood of duplication or confusion of endeavor. The field to be covered is so large that in no other way can intensive work be successfully attempted.

The early ideas of museum exhibition gave rise to halls filled with a large number of specimens mounted as individuals, the emphasis being upon the number of different species which might be assembled. The fact that often many of the species were so similar that such a display soon acquired an appearance of monotonous familiarity for the visitor did not act as a deterrent to this tendency. The large collection of Primates upon exhibition presented, for instance, long series of monkeys grasping limbs, facing the visitor or staring one another out of countenance, rubbing noses or tails as their pedestals happened to be turned. Such an exhibition made many strange companions, and the larger it became, the more heterogeneous it grew. Painted backgrounds, accessory material, and an attempt at natural grouping were all developments of what might be termed the zoölogical renaissance, which was just beginning to make itself felt. The larger mammals—deer, bear, etc.—were stuffed, with such generous employment of plaster of Paris that they could be moved only with difficulty, while the art of the sculptor and modeler was conspicuously absent.

The department took a step in the right direction, and with the installation of the bison group began a series that was to become dominant in the mammal halls. This group was a carefully planned attempt to tell something of the life of the bison, showing not only a natural grouping of several individuals in characteristic poses, but much of this mammal's environment as well. This is a "habitat" group and its exhibition value is many fold that of an equal number of individually mounted bison. The moose group followed in 1895, and thereafter many groups came into being, each based upon the conception that something more than the size and color of an animal must be shown, and with the completion of each group came experience and increased appreciation of the possibilities inherent in the method.

A hall, designated as the North American mammal hall, was given over entirely to mammals of that continent and plans were evolved for similar halls devoted to other continents: one for South America, another for Asia, a third for Africa, a fourth for the marine mammals, and a fifth for Australia. Unfortunately for the realization of this plan, the halls have been in existence only on paper, and the valuable material being held for mounting cannot be utilized for lack of exhibition space. Every possible foot of floor space has been filled and some excellent groups have been installed, gradually driving out the older mounts of the Maximilian and Verreaux collections until today the habitat group is the rule rather than the exception. There can be no question that this change has been approved by the public. Among the more notable of these groups, some of which are today exhibited under circumstances which prohibit the fullest possible display of every feature, are those of the wapiti, the pronghorn, muskox, caribou, beaver, wolf, elephant-seal, and many others as well. Huge mammals, such as the whale, have been placed on exhibition, as well as a group of stupendous African elephants. The progress in methods of preparation has so far advanced that the largest mounted mammals may be moved with ease, and yet are far more permanent than the heavy mounts of fifty years ago. Great as has been the development and improvement of the mounted mammal exhibits, the expansion and attainment would have been even more impressive had they not been held in check by the lack of hall space.

Recent developments, whereby the Museum has received appropriations for new buildings, promise an opportunity for much-needed growth and expansion. A spacious hall of marine life will have exhibits of the whales, porpoises, and other cetaceans. Material for this hall has been collected by Mr. Roy Chapman Andrews in many seas, and comprises



MR. CARL E. AKELEY AT WORK

He who builds up a modern group of mammals must first of all know his animals, secondly he must visualize the best possible result to be attained, following which he must call forth the powers of the sculptor and of the artist in color in addition to his practical knowledge of the manipulation and handling of skins. A group may be months or even years in the making but the final result is well worth the effort, for it is true to life, it is permanent, and it tells a story in a manner that can be appreciated by every one

THE BEAVER GROUP

Most of the accessory material used in this exhibit is the actual wood and débris from a Colorado beaver dam. In the background skillful joining of actual objects with painted images secures the desired effect of realism animals of great popular interest. The new southeast wing, now under construction, will house the hall of Asiatic and European mammals. Specimens for this exhibit have been brought together by different expeditions, the most important of which is the Third Asiatic Expedition, under the charge of Mr. Roy Chapman Andrews, now in the field. Considering the large scale upon which the Asiatic mammals are being collected, and the fact that the exhibits can be planned with reference to an absolutely new setting, the hall of Asiatic and European mammals, when completed, should be the finest thing of its kind.

Upon the death in August, 1921, of the department's first curator, Dr. Joel Asaph Allen, the trustees of the American Museum dedicated to his memory the hall of North American mammals, the oldest and best-known of the exhibition halls. This hall is now known as the Allen hall of North American mammals, in honor of the man whose activities played such a large part in the development of modern mammalogy.

In recognition of the value of the mammal exhibits to the serious-minded student as well as to the lay public, a hall has been given over to the story of mammalian evolution. This hall, known as synoptic hall, illustrates the category of mammals in their development from the lowest to the highest.

Beginning with the purchase of collections already formed, the department soon began to send its own expeditions into the field in the search for material, and so successful have these expeditions been that, largely through their activities, the mammal collection aggregates today about 50,000 specimens. Lack of space forbids the listing in detail of the many and important expeditions which have gone out from the department of mammals. Furthermore, the greater number of these have already been tabulated in the columns of NATURAL HISTORY[1] by

This exhibit, showing the texture of bones in relation to habits, is one of many similar displays in the synoptic hall of mammals. This hall is frequently visited by classes in zoölogy and evolution

[1]July-August issue, pp. 311-13.

To keep the large collection of mammal skins and skeletons where they will be secure from insect attack or the fading agency of the sunlight, a great number of storage units are needed. These are installed in the different rooms of the mammal department, but the collections have outgrown the space within the department and a long row of cases filled with skins is temporarily placed along the main hallway of the fifth floor

Dr. Frank M. Chapman, for nearly all of the expeditions which were sent out to obtain birds were charged also with the collecting of mammals.

The first organized expedition was that sent out for bison in 1886, under Dr. D. G. Elliot and Mr. Jenness Richardson. Later, parties combed western North America for other mammals, the fields of research extending from Alaska to Mexico. Arctic America contributed her share when Captain Comer in 1902, and, subsequently Admiral Peary, brought back many northern species.

Mr. Roy Chapman Andrews made a number of trips for cetaceans and amassed material for the proposed hall of marine mammals, and later, turning to the Orient, made trips to Korea, Thibet, China, and other parts of Asia in search of mammals for the Asiatic hall. Many hundreds of specimens gathered on these expeditions have enriched the study collections of the department. Work was carried on in South America and the West Indies. In Ecuador, Mr. H. E. Anthony collected large series of mammals as well as in Panama, Porto Rico, Cuba, and Jamaica. The finest of all the mammal collections was made in Africa, under Mr. Herbert Lang, who brought back a vast amount of mammalian material after six years spent in the field. Expeditions of the department in the field to-day include the Third Asiatic Expedition, two collectors in Ecuador, and an expedition in Australia. Furthermore, an important expedition is about to leave for India.

The numerous field expeditions have provided the research material for many scientific papers and reports. Dr. Allen was indefatigable in his study of the mammals obtained and published many volumes based upon them.[1] The more noteworthy of these publications from the department of mammals are, by Doctor Allen, numerous studies of South American mammals, "Review of the South American Sciuridæ," "Ontogenetic and Other Variations in Musk Oxen," "Mammalia of Southern Patagonia," many papers on North American mam-

[1]For a detailed list of the writings of Doctor Allen, up to 1916, see *Autobiographical Notes and a Bibliography of the Scientific Publications of Joel Asaph Allen*, published by the American Museum of Natural History in 1916.

A section of the Jack rabbit group is shown to demonstrate how fidelity to actual living environment is secured. All of the brush, the grass, the flowers, and even the pebbles and earth for this group were taken up from an area the size of the group, at the locality where the rabbits were collected, were treated by the preparator, and used in the composition of the exhibit

The polar bear group

mals, and some long and very important works based upon African mammals; by Mr. Andrews, monographs on the cetaceans; by Mr. Anthony, papers on mammals from western North America, from South America, from the West Indies and *The Indigenous Land Mammals of Porto Rico, Living and Extinct;* and by Mr. Lang, papers based upon his collections made in Africa.

The care of the study collections has entailed no little trouble, expense, and thought. When the series was small, the problem appeared to be solved by storage in the so-called "Cambridge cans." With the growth of the collections such facilities were no longer adequate, and the difficulties which accompany expansion were insistently manifest. The installation of large, steel, insect-proof storage units has been under way for several years, and the eventual housing of the entire study series of skins and osteological material in such units will be a long stride in the right direction.

A few additional items to indicate the scope of the work in the department will be touched upon briefly here. Card catalogues of all publications upon mammals are kept up to date, the sum total of such cards being many thousands. The collections are being card-catalogued as well, a card for every specimen, in order that there may be a complete and condensed record of everything in the collections. Maps are made, often of regions inadequately represented before, and the best cartographer obtainable is employed, because the department finds that particular geographical areas in which it is interested have not been worked up by the geographers. Lectures on various subjects are given by the different members of the department: some of these are based upon explorations, others present the results of scientific research and are given before scientific societies. Specimens are loaned to, borrowed from, or exchanged with other scientific institutions, material is identified and named whenever it is sent in for that purpose, and numerous written inquiries upon many subjects must be answered. Scientific research occupies all of the energies of the department when the personnel is not engaged upon exhibition plans, the preparation of popular accounts or lectures, or routine matters, and so many are the interesting problems in mammalogy waiting to be solved, that the mammalogist often regrets that the day contains so few working hours and is apt to spend his annual vacation in the way that gives him the keenest pleasure he knows of, namely, the pursuit of his pet piece of research. The major problems now before the department of mammals are the distribution, the relationships, and the habits of the mammals of Asia, the mammals of the Belgian Congo, and the mammals of Ecuador, and the fauna of the West Indies and the light it throws on the origin of these islands. A year has just been spent in investigating the fur trade as the principal factor in the threatened extermination of many of the world's mammals.

This short article has outlined the more obvious steps in the growth of the department of mammals and has drawn attention to a few of the functions that the personnel are called upon to perform. The progress achieved by the department, from the time it began and Dr. Allen entered the first data in the department catalogues, up to the present, when it requires the greater part of the time of two assistants merely to care for the collections, has been considerable, but the promise of the immediate future is such that the development of the department need not lag. In fact, with increased opportunities, the department should to an even greater extent justify its existence to layman and scientist on economic, æsthetic, and didactic grounds.

Research and study is carried on in the offices and laboratories on the fifth floor, where the great bulk of the mammal collection is stored and where the material for examination is kept close at hand

Photograph by Ira A. Williams

The perfect conical form of Mount St. Helens is a wonderful example of a volcano that ceased eruption less than a hundred years ago. There is a crater in its top and several glaciers cling about its slopes. The mountain rises above the enclosing forest as a conspicuous landmark that has served to guide the path of explorers from the time of Lewis and Clark's first expedition and the early operations of the Hudson Bay Company to the present

TREE CASTS IN RECENT LAVA

OBSERVATIONS MADE NEAR MOUNT ST. HELENS, WASHINGTON

BY

IRA A. WILLIAMS*

WHEN it is stated as a historical fact that Mount St. Helens, a volcanic peak in southwestern Washington, was in eruption repeatedly up to 1842, we are not surprised to find upon its slopes and in the country round about its base many of the interesting phenomena which usually accompany the forceful ejection of large quantities of liquid lavas.

St. Helens rises to an altitude of 9671 feet as a great white cone visible in all directions for many miles. It is located well down the west slope of the main Cascade Range of mountains in the forest belt of western Washington. Although glaciers still exist upon it, its almost perfect conical outline is doubtless due to the fact that these ice-streams have not gouged or marred to any extent the higher parts, the graceful lines of which are still those given to it largely by the falls of ash and cinders and scoria that resulted from the final more violent paroxysms of eruptive effort.

About the base of this mountain liquid lavas broke out in the past at many points. In response to the pull of gravity these flows settled into the lowest portions of the surrounding land surface, which were then, as now, the radiating stream cañons of the region. Down several of these cañons the molten lavas flowed for many miles, filling them up and diverting the streams which occupied them—in instances, damming side-streams so as to form swamps or lakes of their waters.

Forest growth encroached upon this actively erupting volcano. Indeed, long

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Photograph by Ira A. Williams

The original forest growth closely fringes the borders of the lava field and, as the beginnings of soil formation permit, vegetation gains a foothold on even the rough lava surface itself

before it settled into a state of quiescence, it was surrounded by one of the most luxuriant stands of fir timber in the entire Northwest. Its later flows, therefore, in their progress down its lower slopes met and overwhelmed portions of the upper fringes of this forest mantle. Today heavy stands of trees come to the very edge of rough and barren lava fields, although, when the lava flow occurred, it consumed with heat or inundated all the vegetable life that was in its path. In age these new lava fields vary from a state of youth so fresh that a scant bit of clinging moss or lichen is the only evidence of plant life, to surfaces on which, though as yet showing only the merest beginnings of soil formation, scattered evergreens of fair size have gained a precarious foothold.

The Kalama River, which heads upon the southwest slope of Mount St. Helens, is one of the larger of several streams that receive their water largely from the melting snows of this Fujiyama of the Pacific Coast. The character of the upper portions of the cañon of this river has been much altered and, in fact, determined mostly by glacial action and successive flows of lava, which have shifted the course of its waters repeatedly. One of the last of the lava flows found its way down the cañon of the Kalama River to a point approximately twelve miles in a line due southwest from the summit of the mountain. In its progress to this point a heavy forest growth was apparently overcome and swept away. Some evidence as to the manner in which the large trees of such a forest were destroyed is illustrated by the accompanying photographs.

The views are of portions of the lava surface taken near the border of the Kalama flow, in about Sec. 7, of Twp. 7 N. R. 4 E., Cowlitz County, Washington. The broken lava is here covered to some extent by a growth of grasses and shrubs and a sparse stand of forest trees. These trees tell us that, although the flow is so little obscured that every swirl of lava current can be seen, a hundred years and more have doubtless elapsed since the lava came to rest and solidified where we now find it. The surface of the flow is an uneven one. There are the pits and pressure domes and ridges, the hummocks of broken angular blocks, the corrugations, all of which are the outward expression of the strains to which the hot viscous mass was subjected in coming to a final position of rest.

In places circular holes appear in the surface of the lava. Some are horizontal, some vertical. On exploration these prove to be the casts of tree trunks in the solid rock. The "tree tunnel" shown in the photograph below has a bore four feet across and may be entered for a distance of from thirty-five to forty feet. In the center, above this "portal," the flat-lying twig indicates the position and diameter of a still larger "tree well." This well is from four to four and a half feet in diameter, round, and quite open throughout its full depth of thirty feet or so. In its bottom, which is also the base of the lava flow and the old soil on which the tree grew, one may catch the glint and hear the ripple of running water; thus, literally, as well as figuratively, a well in the ordinary sense of the term.

A fact of interest is that at a few feet below its top a small opening connects the tree well with the tree tunnel and admits a shaft of light the reflection of which is but dimly discernible in the photograph. The inference is inescapable that here the moving lava surrounded a gigantic growing forest tree which, though in all probability quickly consumed, did withstand the fiery onset for a sufficient space of time to congeal about it a casement of such thickness and rigidity as to indicate to us today its former size and position. The top portion of perhaps this same tree or of another of equal or even larger proportions was toppled over. Its weight was great enough to cause it to sink slowly into the viscous lava, by which it was completely covered. While the forward motion of the thickening magma must have been slight at this time, such movement as there was could have floated this log along until it met the upright tree or incasement al-

Photograph by Ira A. Williams

A tree tunnel in the lava that has a diameter of four feet and may be entered for a distance of from thirty-five to forty feet

IMPRESS LEFT BY A CONSUMED GIANT OF THE FOREST

The impression of a large tree in the solid lava, produced by the impact of the fall of the tree and the pressure of its weight while recumbent. At the left a single ring of lava (seen more clearly in the picture on the opposing page) surrounds the opening, and still beyond is a short length of "tunnel" with daylight showing through. The tree was from four to five feet in diameter if one may judge by the dimensions of the shell it has left. The narrow ring, or arch, may be either a remnant of the collapsed roof shell that, at the time of the lava flow, covered the log entirely; or, as likely, the still intact bridge that was formed when a viscid tongue of the stiffly flowing mass was pushed across the prostrate tree till it found support at the downstream side. (Photograph by Ira A. Williams)

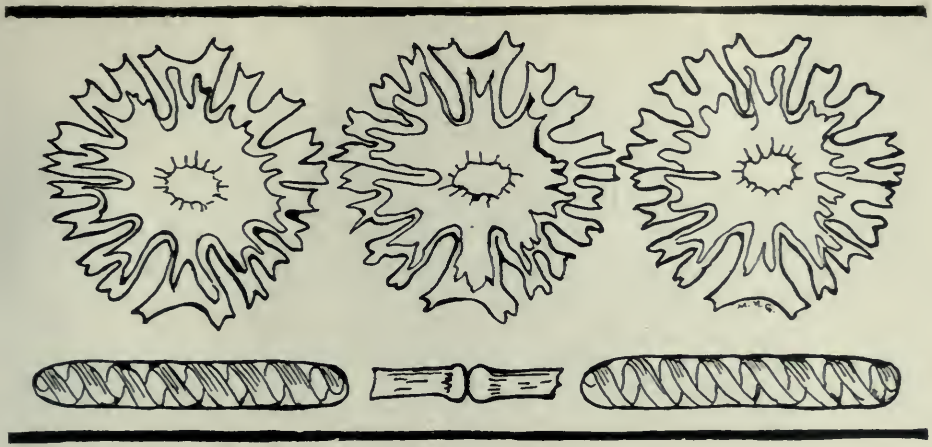
CLOSER VIEW OF THE SAME TREE CAST

In this picture the space intervening between the encircling ring of lava and the short tunnel beyond is more clearly indicated than in the opposing photograph. There is probably evidence in the series of joint blocks that form the left abutment of this ring, or span, of the more sudden hardening of the lava in contact with the tree, even though in the consumption of the substance of the tree considerable heat must, momentarily, have been produced. Evidence of actual contact of the liquid lava with the scorched surface of the burning tree is to be seen in nearly every one of many tree casts. At the right of the person in the view the polygonal markings are the expression in the now solid rock of the charred surface of the wood when the soft lava first took shape around it. (Photograph by Ira A. Williams) ready formed about it, there to come to rest and in turn suffer ultimate cremation. Its disappearance left the conspicuous annular opening which arouses our wondering interest today.

It is not easy to visualize the exact events attending the submergence and destruction of a forest growth by the forward and spreading movement of a body of highly heated, liquid lava. On its approach all shrubbery and smaller trees would certainly first be withered, then completely burned, in advance of actual contact with the molten lava. Only large trees would stand until surrounded by the scathing deluge and these doubtless would be seared from base to top before their undermining was completed and resulted in their fall. Though wood impressions are plentiful, none of the bark of a tree has been observed. It would seem that the ready combustibility of the bark and of the smaller branches doubtless accounts for the universal absence of their imprints. They were entirely burned away while the tree was yet upright, or so quickly following its fall that preservation of their markings was never accomplished. Indeed, only a favorable consistency of the lava after forward movement had practically ceased, and a temperature near the solidifying point, could effect, first of all the forming of the tree casts themselves and, in the second place, though much less frequently, the taking of the imprint of the burning wood and its indelible retention in a wall of the lava as we see it today.

Photograph by Ira A. Williams

Close view of the wood impressions noted in the preceding photograph. These are not the stamp of the bark of a tree but are a replica in reverse of the characteristic surface features of wood that has been not merely seared but deeply burned and changed to charcoal



NATURE STUDY WITH THE MICROSCOPE

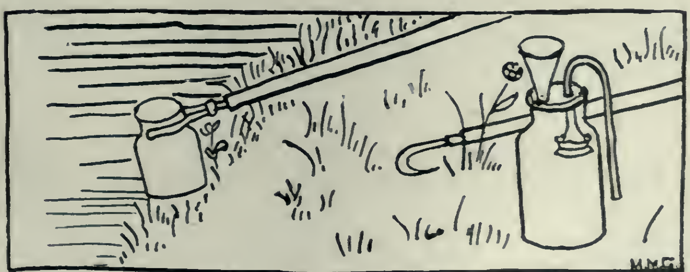
BY

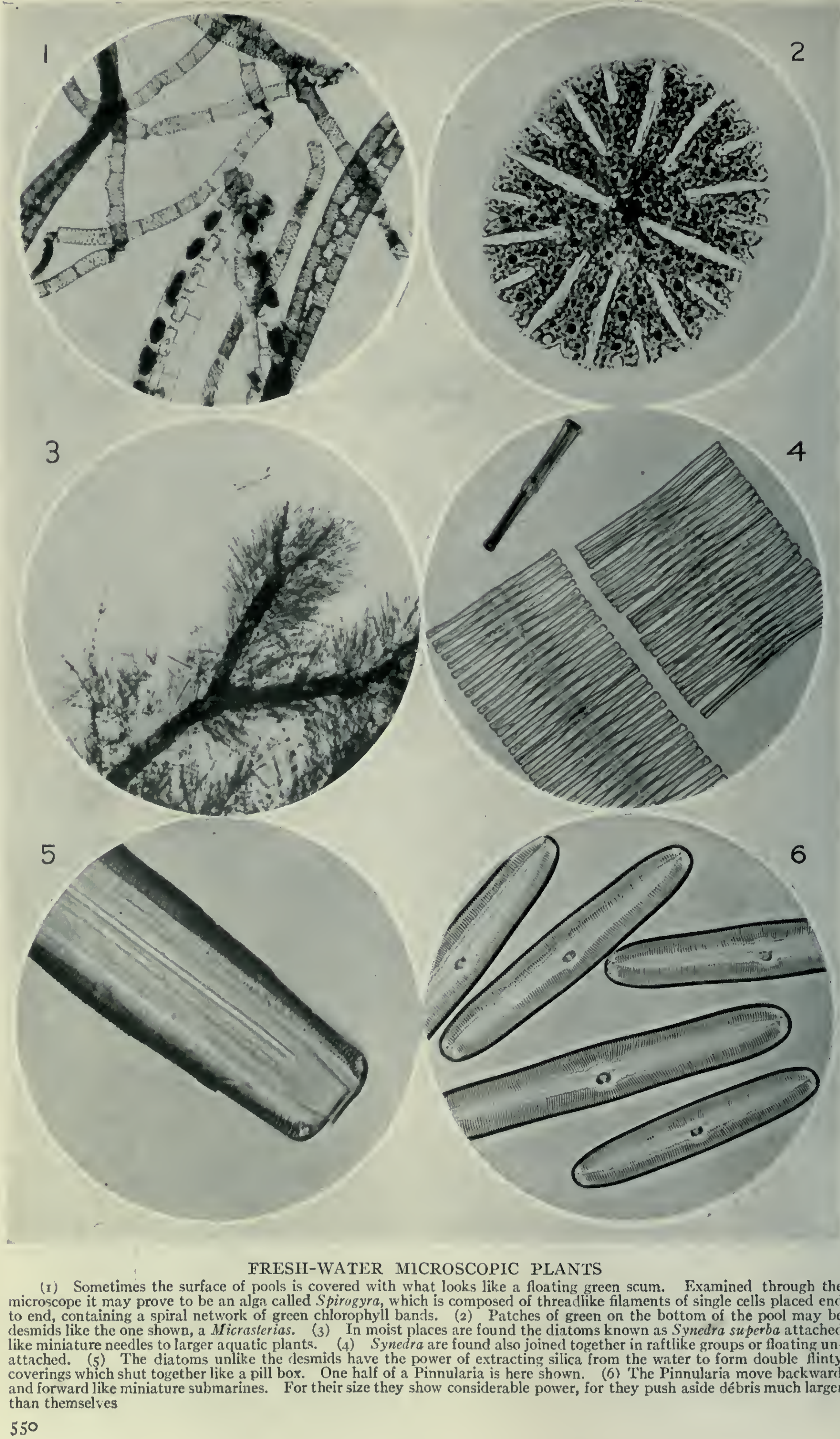
PHILIP O. GRAVELLE

THE interest shown in various branches of nature study, with the constant accessions to the ranks of nature lovers, should lead us to consider the advantages placed at our disposal by the use of the microscope. Those who are fortunate enough to possess such an instrument appreciate the extensive field open to them and are gaining a finer insight into the wonders of nature. They can correlate their observations with those of others and with persistence may even happen upon hitherto unknown stages in the life history of the organisms under examination.

The nature student of today hunts with binoculars and camera instead of with trap and gun. Moreover, it is only a limited part of the living world that reveals itself to the unaided eye. In botany and zoölogy a long scale exists in which plants and animals diminish in size, until we can no longer recognize their form or functions without the assistance of optical instruments.

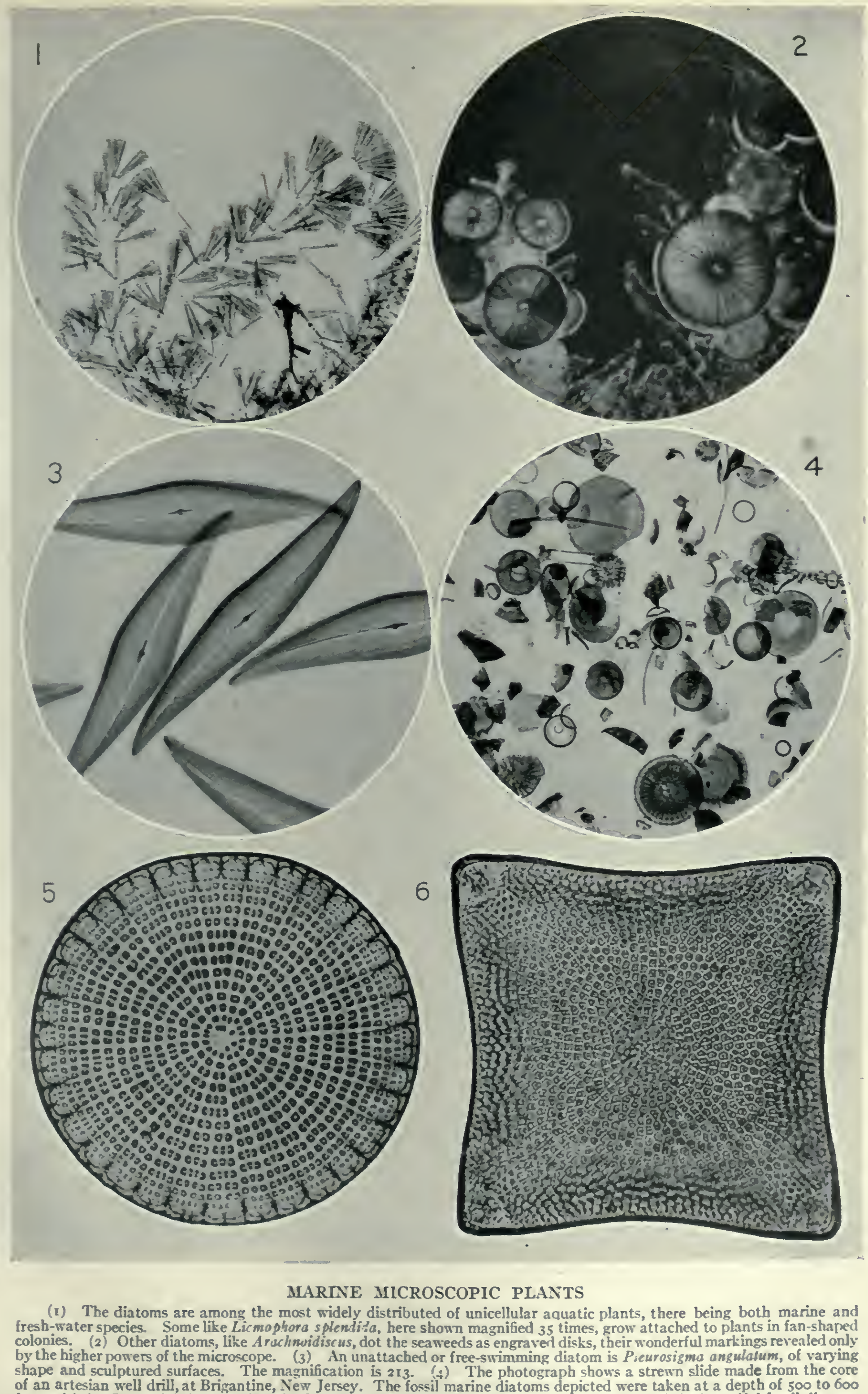
Our first aid is the hand lens or simple microscope, which magnifies up to eight or ten diameters. Beyond this the compound microscope is necessary to show structure and detail in a better manner. How much in our environment of which we are ordinarily unaware can be made manifest through the microscope and how interesting are the details of structure of some of the smaller creatures with which we are familiar, are indicated in the illustrations that follow.





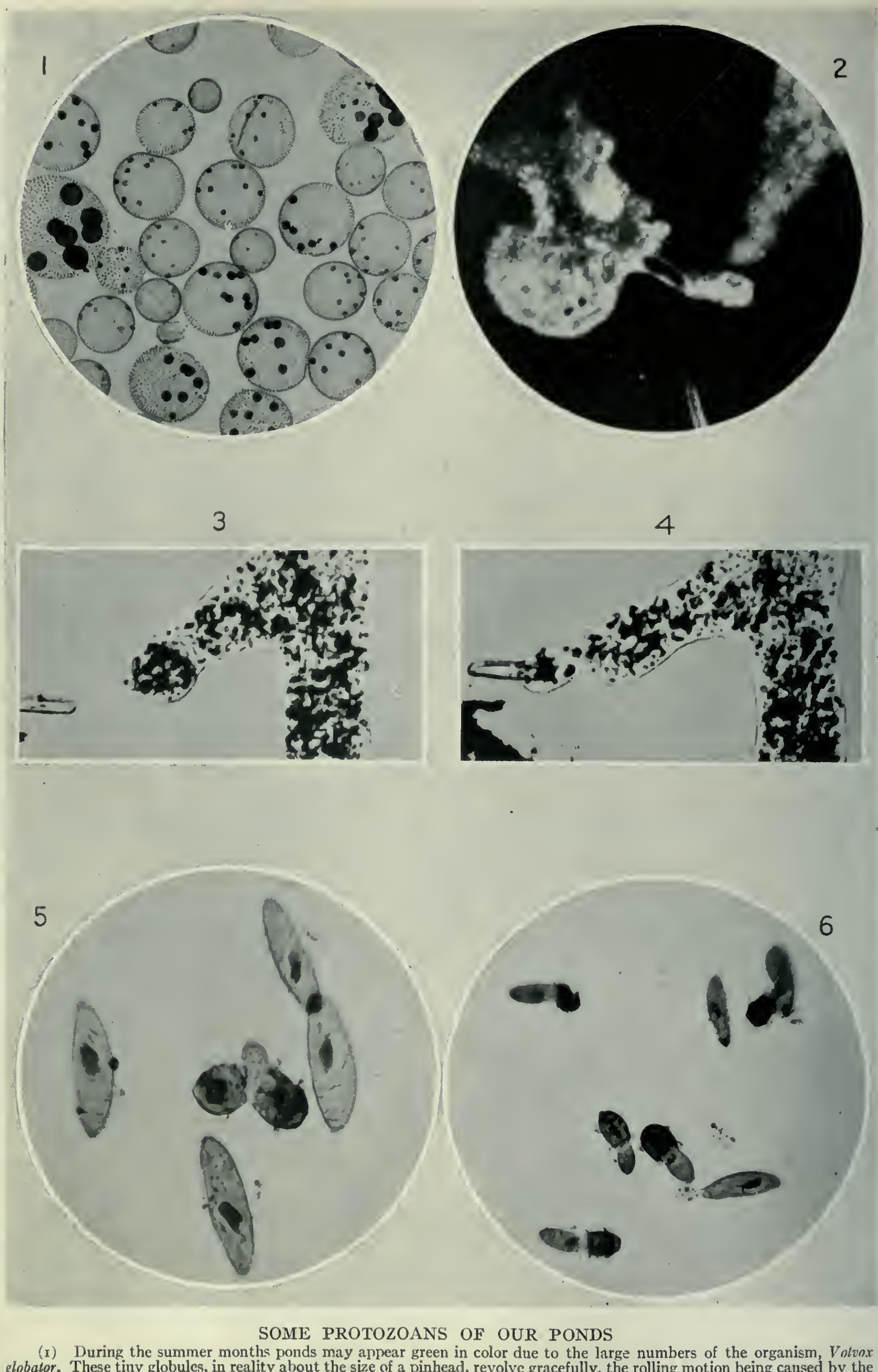
FRESH-WATER MICROSCOPIC PLANTS

(1) Sometimes the surface of pools is covered with what looks like a floating green scum. Examined through the microscope it may prove to be an alga called *Spirogyra*, which is composed of threadlike filaments of single cells placed end to end, containing a spiral network of green chlorophyll bands. (2) Patches of green on the bottom of the pool may be desmids like the one shown, a *Micrasterias*. (3) In moist places are found the diatoms known as *Synedra superba* attached like miniature needles to larger aquatic plants. (4) *Synedra* are found also joined together in raftlike groups or floating unattached. (5) The diatoms unlike the desmids have the power of extracting silica from the water to form double flinty coverings which shut together like a pill box. One half of a Pinnularia is here shown. (6) The Pinnularia move backward and forward like miniature submarines. For their size they show considerable power, for they push aside débris much larger than themselves



MARINE MICROSCOPIC PLANTS

(1) The diatoms are among the most widely distributed of unicellular aquatic plants, there being both marine and fresh-water species. Some like *Licmophora splendida*, here shown magnified 35 times, grow attached to plants in fan-shaped colonies. (2) Other diatoms, like *Arachnoidiscus*, dot the seaweeds as engraved disks, their wonderful markings revealed only by the higher powers of the microscope. (3) An unattached or free-swimming diatom is *Pleurosigma angulatum*, of varying shape and sculptured surfaces. The magnification is 213. (4) The photograph shows a strewn slide made from the core of an artesian well drill, at Brigantine, New Jersey. The fossil marine diatoms depicted were taken at a depth of 500 to 600 feet. (5)-(6) In Sendai, Japan, a deposit of diatomaceous earth occurs, well known on account of the beautiful fossil diatoms found therein. Two of these diatoms are here shown, *Arachnoidiscus indicus* (5) and *Trigonium arcticum* (6)

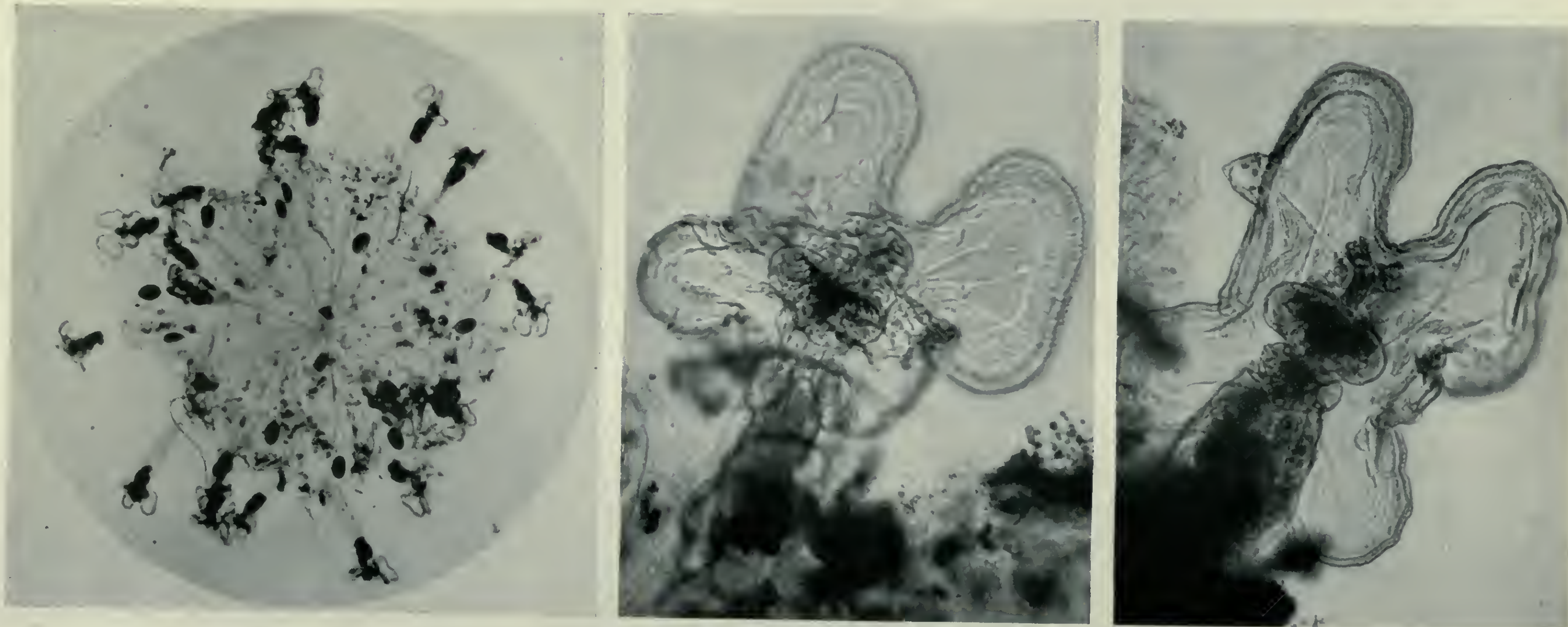


SOME PROTOZOANS OF OUR PONDS

(1) During the summer months ponds may appear green in color due to the large numbers of the organism, *Volvox globator.* These tiny globules, in reality about the size of a pinhead, revolve gracefully, the rolling motion being caused by the vibration of fine hairs or cilia covering the globe. The dark markings are smaller spheres in process of development within the parent spheres. (2) This is a dark-field photograph taken from a motion-picture film of *Amœba proteus.* The organism multiplies by simple division, two animals taking the place of one. In (3) and (4) another phase of the activities of *Amœba proteus* is shown. In (3) the *Amœba* is extending a pseudopodium toward a diatom floating conveniently near. In (4) the pseudopodium has been further elongated and is surrounding the diatom. In (5) two cup-shaped animals, *Didinium,* are engaged in consuming jointly a single *Paramecium,* neglecting the free-swimming prey that is temptingly near. In (6) there is a better distribution of effort, each *Didinium* having taken exclusive possession of a *Paramecium.* The magnification in (5) is 86 diameters, that in (6) is 54

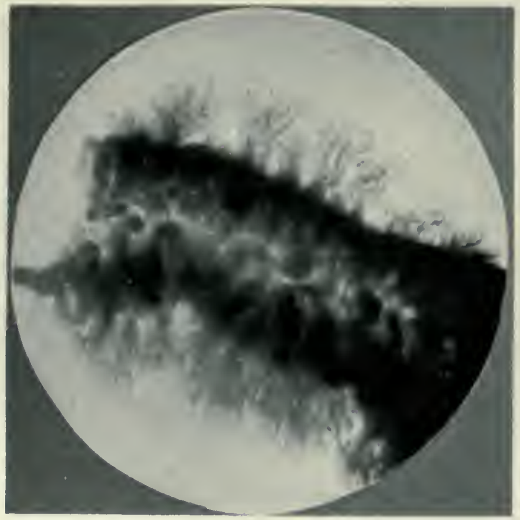
ROTIFERS FOUND IN FRESH-WATER PONDS

(1) A group of rotifers, *Asplanchn· silvestrii*, from Devil's Lake, North Dakota. Through the transparent body can be seen the various organs. (2) One of these organs, the mastax, is furnished with chitinous jaws, which are used in preparing food for digestion. Three pairs of these jaws, detached from three rotifers, are shown in this picture. It is the possession of such jaws that distinguishes the rotifer from all other microscopic animals. The magnification is 186. (3)–(4)–(5) Great variation in the shape of free-swimming rotifers is here shown. The figures represent respectively *Apsilus vorax* (magnification 60), *Brachionus falcatus* (magnification 75), and *Triarthra longiseta* (magnification 90.) (6) It is the ambition of every student of microscopic life to find the crown animalcule, *Stephanoceros eichhorni*. This rotifer is about one-fifteenth of an inch in length and is fitted with a crown of five spreading arms, fringed with hairs or cilia in rapid motion. These create a vortex in the water whereby food is brought to the animal's mouth. All of the illustrations shown on this page are made from photographs of specimens in the American Museum



A ROTIFER IN ACTION

Three pictures of the rotifer, *Octotrocha speciosa*. During the early summer months this rotifer dwells in colonies upon submerged leaves. If one of these leaves be taken from the water and examined with a good hand lens, little globules of a jelly-like substance may be seen. Watching one of these closely, one detects a show of animation within the gelatinous matrix. The individuals of the colony—for that is what the globule consists of—are extending beyond their transparent abode, unfolding like the petals of a flower, yet without losing contact with the jelly mass, for the footstalk of each individual has anchorage in the common center. The picture on the left shows a colony; those at the center and right successive views of an individual unfolded, with its cilia in rapid vibration, thereby causing food particles to stream toward the mouth. Within the animal can be seen the working jaws. The pictures at the center and right are reproduced from motion-picture photographs of living specimens

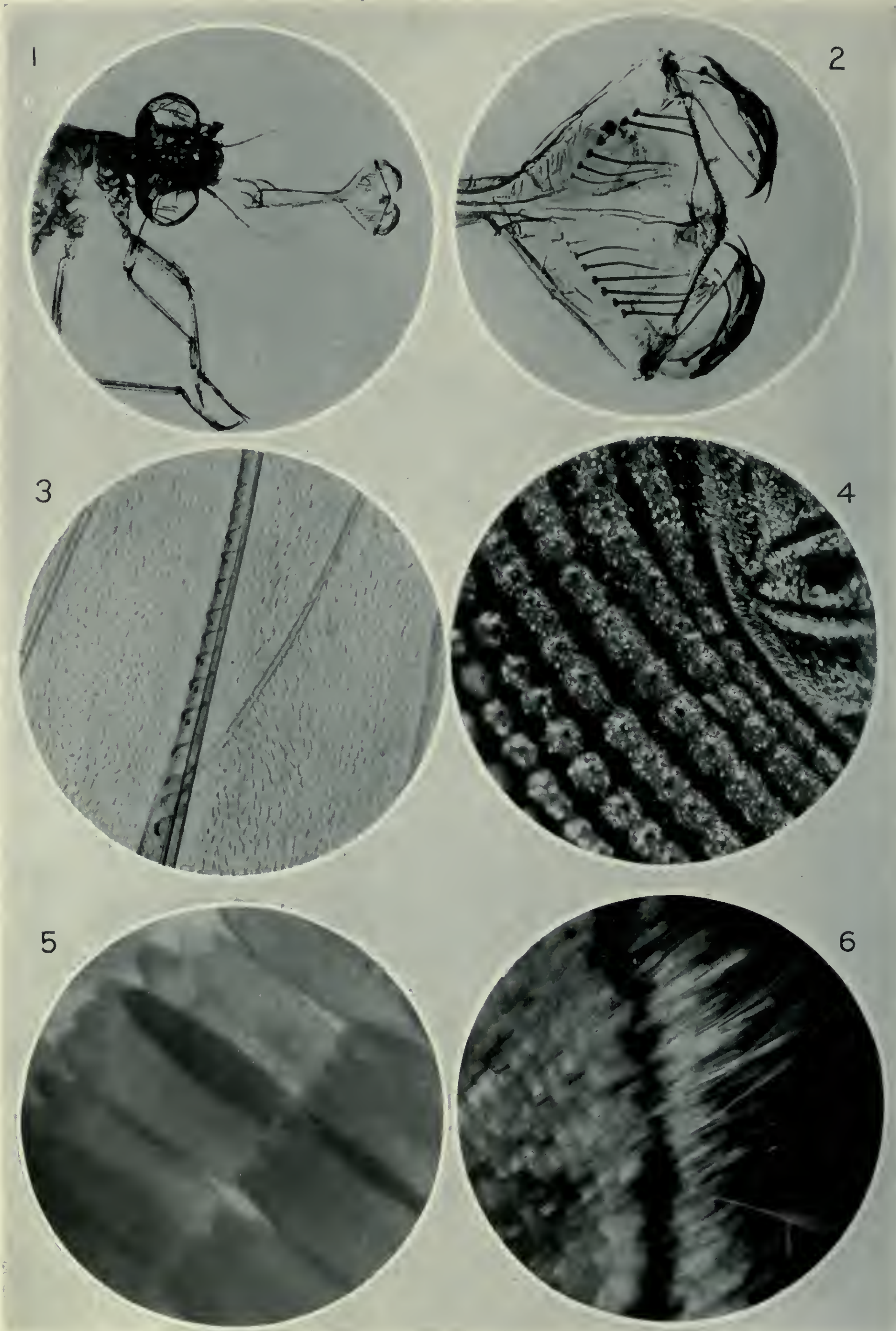


OTHER CREATURES THAT REPAY STUDY

Another group of animals living in colonies are the Polyzoa. *Cristatella,* shown on the left, is unique among the Polyzoa in that the whole colony can move about of its own accord. The colony, of which a portion only is seen here, is united into a body of oval shape, rounded above and flattened below, adhering by means of the under surface. The colonies, from one half to two inches in length and about one eighth of an inch wide, are found in shallow water with tentacles thrust out and shining in the sunlight. The magnification is 9.

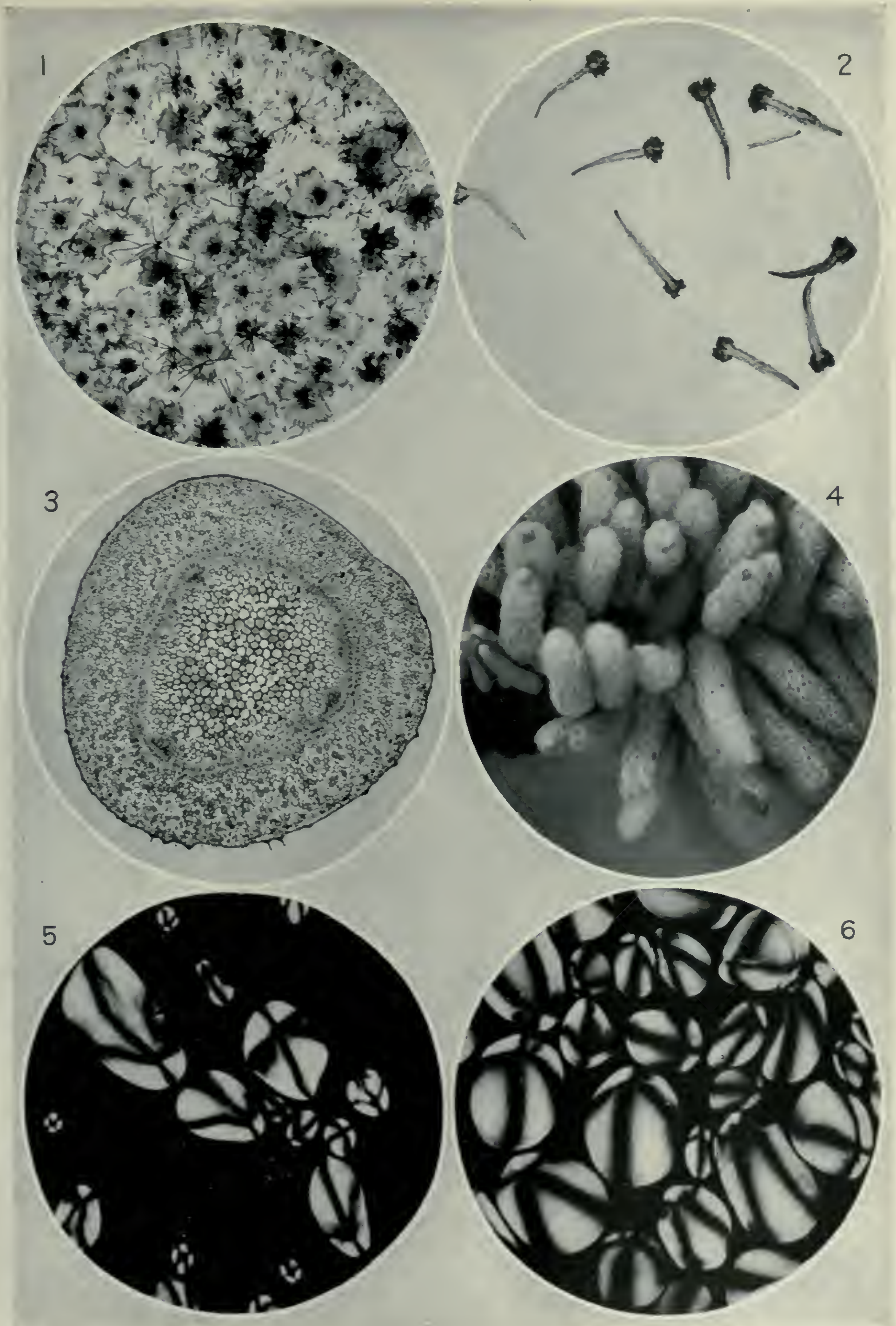
The other two pictures are of crustaceans. That in the center represents a common cyclops, with a single eye in the middle of its head. The creature, though microscopic in size, is not inaptly named after the one-eyed giants of Greek mythology. Attached to its body is another organism, *Carchesium,* a protozoan parasitic upon the cyclops.

The water flea, *Bosmina longirostris,* magnified 140 times, is shown on the right. Needless to say, it is not a true flea, but the way it jumps about in the water suggests the mode of progress of a flea. The transparency of this crustacean reveals every detail of the creature's structure. Note the two eggs within the body



MINUTE PARTS OF INSECTS

(1)-(2) The young of the dragon fly, unlike their swift-flying parents, are sluggish creatures. They live in water and lie in wait for their prey. As this approaches, the young dragon fly shoots out from its mouth its jointed lower lip, armed with pincers for gripping the victim. These pincers, enlarged 34 diameters, are shown in (2). (3) The hooks and grooves connecting the front and rear wings of a wasp. These wings operate as one when the insect is flying. (4) Side markings on the Brazilian diamond beetle. The pitted surface of this beetle is richly sprinkled with brilliant greenish gold scales, which sparkle like diamond dust. (5) Scales on the wing of a butterfly. Magnification, 370 diameters. (6) This picture shows the scales along the edge of the wing, which differ from the inner scales. Even the inner scales present differences in various portions of the wing, notably so in the male of certain species



DETAILS OF PLANT LIFE REVEALED

(1) Epidermal organs of the buffalo berry, *Shepherdia* or *Lepargyrea*. Magnified 15 diameters. (2) The spines of the strawberry, 8 times their natural size. These miniature carpet tacks may account for the uncomfortable irritation complained of by some people after eating the berries. (3) A cross section of the stem of a geranium, showing the arrangement of the cells. The photograph is 9 times the size of the original. (4) Fungi, too, may be made the subject of microscopic study. The fungus here shown belongs to the Myxomycetes, or slime molds, formerly regarded as animals, Mycetozoa. This fungus is usually found in damp woods, attached to dead stumps or the dead branches of trees. (5) The starch of the potato under polarized light. This starch has a characteristic oyster-like shape different in outline from the starch taken from the root of the canna, which is shown in (6). The magnification in each case is 200 diameters

THE WORSHIP OF THE CEDAR TREE

This tree, which had been cut down some days before the ceremonies described in this article took place, was erected in the open plain. Prayers and songs were addressed to it, tobacco smoke was blown upon it, and the ashes of the pipe were sprinkled over it and deposited at its base

INDIAN CEREMONIES OF THE LONG AGO

A REVIVAL BY THE ARIKARA OF NORTH DAKOTA OF SOME OF THEIR ANCIENT, DISUSED RITES

BY

PLINY E. GODDARD*

CLASSFIED according to their ways of living, there were formerly on the Great Plains two fairly distinct groups of Indians. To the public of today the more familiar of the two are the buffalo-hunting, nomadic tribes that practised no agriculture. In this group are the Teton Dakota, the Arapaho, the Cheyenne, the Crow, the Blackfoot, the Kiowa, and others. They were prominent forty years ago because of their war activities, particularly the Dakota, led by Sitting Bull. When the buffalo disappeared, these nomadic tribes were forced to engage in new activities.

The second group of this general region was composed of the Mandan, now practically extinct, the Hidatsa, and the Arikara on the upper Missouri, the Pawnee and Omaha formerly in Nebraska, the Iowa, the Kansas, and Osage in the east and south. In contrast to the members of the first group these tribes were sedentary, living in fairly permanent villages, and practised agriculture. It is true they also hunted buffalo and some of them lived during the winter in skin tipis as did the tribes of the first group.

In the first half of the nineteenth century they were well known to the reading public. Lewis and Clark spent the winter of 1804–5 among the Mandan. In 1833 the villages of the Missouri were visited by Maximilian, Prince of Wied, who published a beautifully illustrated account of his journey. George Catlin, who was with them about the same time, brought them to the attention of the public through his writings and his pictures. He made a number of studies in oil, uniform in size, which were shown in Europe and America. Many of his originals were presented to the American Museum by Mr. Ogden Mills.

Except for a short flurry over Mandan corn during the war, concerning which an article appeared in NATURAL HISTORY,[1] little attention has in recent years been paid to these tribes, reduced as they are in numbers. The Mandan long ago discontinued the Okipa ceremony, Catlin's account of which was thought at first exaggerated and sensational. The public ceremonies of the neighboring tribes, the Hidatsa and Arikara, were also discontinued at the insistence of the Indian Department.

Sometime last year the Arikara approached Dr. Melvin R. Gilmore, of the North Dakota State Historical Society, with the request that he secure permission for them to hold their ceremonies so that a full record of these rites might be made. In carrying out this request Dr. Gilmore, who wished the work done with all possible care, sought the aid of the department of anthropology of the American Museum.

Formerly these agricultural, sedentary Arikara had their dwellings, which were earth-covered houses, grouped closely together in villages. In the middle was a large lodge of the same general structure, which served as the religious and social center. At the present time the Arikara are living in small farm houses scattered over the prairie on either side of the Missouri. They have no villages and no earth-lodges in which an old ceremony could properly be given. They have, however, modernized buildings, one on each side of the river, in which dances and social gatherings are held.

At first the Indians contemplated building a regular earth-lodge, that the

[1] "Indian Corn as a World Food." By Clark Wissler. NATURAL HISTORY, Vol. XVIII, Number 1, pp. 25-9.

*Curator of Ethnology, American Museum.

ONE OF THE MEDICINE SOCIETIES GREETING THE CEDAR TREE

After the tree had been removed from the spot where it had been placed originally (see frontispiece) and erected close to the lodge, or community house, the various medicine societies successively issued from that building in order to visit the tree and to dance, sing, and play

THE MEAT OFFERING

The worshipers are holding willow sticks to which have been tied bits of meat. Prayers were said first in the community house, and then before the tree. At the conclusion of these rites, the worshipers dashed off to deposit the willow sticks out in the prairie ceremony might be perfect in its setting. However, time would not permit their doing so, for the grain harvest was not yet garnered and much wild hay had to be cut for the winter. Moreover, the community house on the left side of the river was in the general form of the earth-lodges and lent itself to the requirements of the ceremony.

The investigating party consisted of Dr. Melvin R. Gilmore, curator of the North Dakota Historical Society, Mr. George F. Will, of Bismarck, a local archæologist and ethnologist; Miss Gladys A. Reichard, assistant in anthropology at Barnard College; and the writer, P. E. Goddard, curator of ethnology of the American Museum of Natural History.

On Sunday evening, August 14, 1921, we were met by the Arikara in council to consider plans. On Monday afternoon there was a preliminary assembly, during which an invocation was made to Mother Earth advising her of the intention to hold the ceremony. Songs were sung which narrated the creation of the earth and the early history of the Arikara tribe.

After a period devoted to ceremonial smoking, the various medicine societies, seated in order around the house, delivered their songs. The owls, for example, sang of the creation of that bird at the beginning of the world and of its continuing until the present day. The other societies mentioned in like manner their eponymic animals.

In the evening at 9:30 the sage dance was given. The older men, dressed in breechcloths and moccasins, knelt at the altar and then danced about a fire in the center of the house. They held bunches of sage in their hands to protect themselves somewhat from the heat of the fire. Because of the nature of the building the fire was not allowed to become very fierce. One could imagine that in earlier days, with many more participants and the men in better athletic condition, the dance must have been highly spectacular.

Tuesday morning the investigating party was invited to be present at the consecration of the cedar tree. This tree had been cut some days previously and placed on the open prairie three hundred or four hundred yards from the house. The priests sat in the grass near the tree and sang for some time, saying, "We are here, we have come for you." The tree was raised and the various priests standing before it in turn sang additional songs as they shook their rattles. Tobacco smoke was blown on the tree and finally the ashes from the pipe were sprinkled on it and placed at its base, where food also was deposited as an offering. The men who were officiating then ate food which was brought to them by attendants.

The tree was lowered again and carried to a position in front of the house door. Offerings of cloth were brought and piled on the tree, a priest blessing each donor by stroking and pressing motions with his hands. Especial care seemed to be taken that small children should participate in and receive the blessing.

The various societies came out of the community house in succession, danced, sang, and played, representing the animals for which they were named. The members of the bear society wore skins of that animal and chased the members of other societies about the space before the house.

The tree was later taken into the house and placed before the altar. The leader of the bear society went to it and pretended to eat of its branches. It was finally taken to a position reserved for it just in front of the door beside a small stone. Both tree and stone were adorned with wrappings of cloth, and the stone was also painted. This stone represents the male supernatural being and the cedar tree the mother earth, or holy grandmother. It appears that the tree and stone constitute the village or tribal shrine. The stone remains permanently, but the tree is replaced each June, the discarded one being sent down the Missouri on the freshet to visit the older village sites.

In order to conclude the ceremony as soon as possible the early morning hours of August 17 were devoted to the preparation of a large bowl of cornmeal mush. The second ceremony, known as Mother Corn, began with the opening of a sacred bundle at 10 A.M. These bundles were mentioned by travelers who visited the Missouri early in the nineteenth century. We were present at the second ceremony and had the opportunity of handling the bundle contents and of asking questions. The main constituent objects were ears of corn, the skins of birds, and scalps. Among the skins was that of a parrakeet, a bird mentioned in Prince Maximilian's list as being on the Missouri, but now so long extinct that the Indians remember it but vaguely. The bundles are handed down from father to son and ordinarily the rituals, consisting of songs, prayers, and myths, are passed along with the bundles themselves. Other Indians than the bundle-guardians often know the ritual. Unfortunately, the rituals of several of the bundles have been lost because of the indifference of their more recent custodians. After the bundle was opened the viscera of a steer (substituted for those of a buffalo) were brought in and put down before the altar. Small pieces of meat were placed on short sticks. After the ceremonial smoking the boys ran out with these sticks, scattered over the prairie, and hid the meat offerings. The viscera mentioned above were placed outside the lodge as an offering.

All the pipes in the camp were gathered up and no one was allowed to smoke outside of the community house. These pipes were later filled and lighted by an attendant and returned to their owners.

The afternoon was devoted to a dance by the women, who held in their hands the old-fashioned hoes made of the shoulder blades of the buffalo. The dancing motion included an imitation of hoeing. During this dance any woman whose garden is weedy may be called upon publicly to come and hoe it. On the other hand, a woman who has a well-kept garden is quickly relieved of her hoe. One of the women danced also with a scalp from the sacred bundle. The scalp was attached to a long stick and was alternately dipped in the dust and waved in the air. Women and children wearing skins of buffalo and of calves circled around the fire and were shot at with bow and arrows taken from the bundle. Sometimes an arrow was thrust between the arm and the body of an individual representing the buffalo, and when that individual, pretending to be mortally wounded, sank to earth, the person who had given the successful thrust withdrew the arrow and wiped it as though desirous of cleansing it after its imagined penetration of the flesh.

The day's ceremony, consisting of the preparation and offering of the bowl of cornmeal mush, the simulation of the act of hoeing the gardens, the offerings of meat, and the killing of buffalo in pantomime, was clearly intended to safeguard and increase the food supply. It was said that the main purpose of the ceremony was to produce favorable weather conditions for the growing corn—it should have taken place in mid-June. Secondarily, war victories were recalled and names were conferred on people of all ages who wished other names.

The Arikara are related in language to the Pawnee from whom they appear to have separated several centuries ago. The religious conceptions of the two tribes are similar and in a broad way their ceremonies are alike. The American Museum possesses several of the Pawnee sacred bundles[1] and Doctor Wissler, assisted by Dr. John R. Swanton of the Bureau of American Ethnology, has taken down the rituals and investigated the ceremonies.

[1] "The Sacred Bundles of the Pawnee." By Clark Wissler. NATURAL HISTORY. Vol. XX, Number 5, pp. 569-71.

It is fortunate that the local interest—that of the Indians and of the Historical Society of North Dakota—has resulted in an opportunity to see and make record of these ceremonies of the Arikara, which are thus made available for comparison with those of the Pawnee and those of the Hidatsa and Mandan. Important conclusions may be drawn as to the pertinacity of religious customs when the Arikara ceremonies are studied in connection with those of the Pawnee, and as to the speed and degree of assimilation when they are compared with those of recent neighbors like the Hidatsa and the Mandan.

"THE CALL OF THE MOUNTAINS"

MR. LE ROY JEFFERS is preeminently fitted for the writing of such a book as *The Call of the Mountains*.[1] He has felt the irresistible appeal of the high places and he has yielded to it season after season, visiting now this range and now that, gathering impressions, storing memories, imbibing the great spiritual influences that the mountains exert. It was due largely to his initiative that the bureau of Associated Mountaineering Clubs of North America was formed, with a constituency of fifty organizations interested in mountaineering, conservation, travel, and the like. In addition to being secretary of this bureau, he is librarian of the American Alpine Club and a member of several organizations having kindred purposes.

The Call of the Mountains is an inspired record of the response which Mr. Jeffers made to the summons that comes from pinnacle and cañon, from snow field and desert. But it is more; it is a chart by which others may find their way into a wonderland of entrancing sights and varied experiences. In a sense the book is a survey of the scenic riches of the United States and of parts of Canada, for so many of the sites worth visiting in North America are locked away in the mountains of that continent. The incidents of the author's thrilling climbs and descents are arranged under five regional headings: "The Northwestern United States and Canada," "Colorado, the Gateway of the West," "Among the Mountains of California," "Wonderlands of Utah and Arizona," "Eastern Scenic Regions." Included under these divisions is now and then a chapter which in the strict sense of the term is not a record of mountaineering and yet is by no means alien to it. The spirit of adventure that prompts a man to lower himself by hand grip down a rope attached to a tree near the edge of a cliff, in order that he may peep into a rock shelter, or that induces him to explore the interior of a cave, feeling for foot grips as he descends in partial or complete darkness, is of a character with that which sustains him on the steep and slippery climb or amid the dangers of descending avalanches. A feeling tribute to John Muir, lover of mountains, and a sketch of the fatal climb of Mount Eon by Dr. W. E. Stone and the rescue of Mrs. Stone after exposure for eight days under unusually trying conditions are fittingly introduced in the course of the narrative.

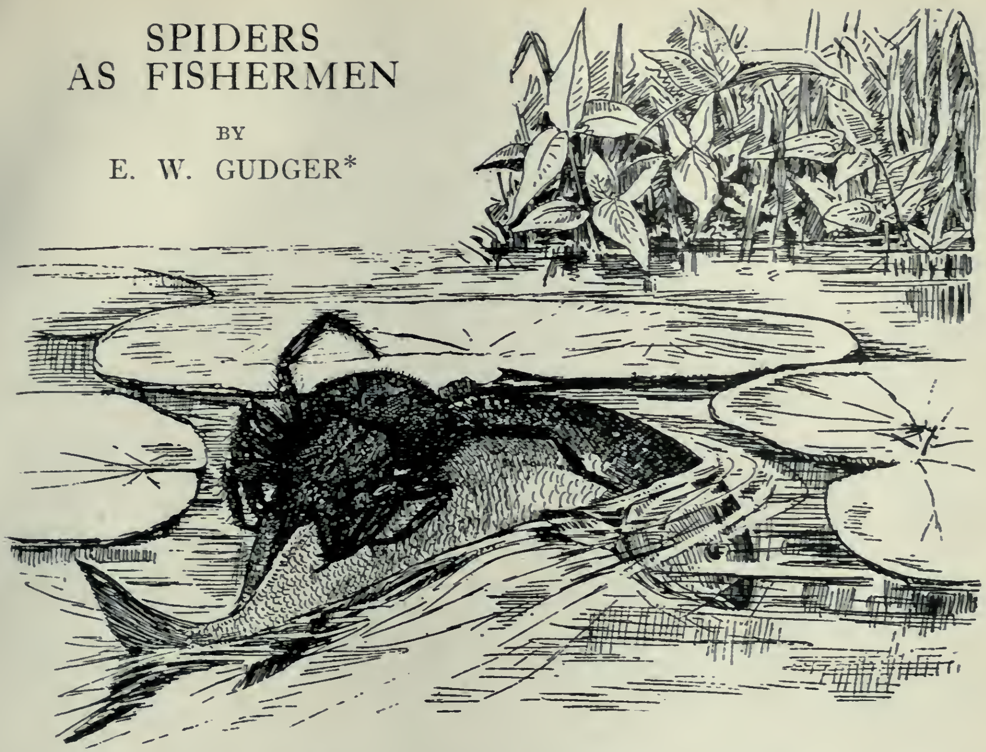
It is to be hoped that this volume, which is illustrated with superb views contributed by a number of well-known nature photographers, will lead to a better realization of the beauty and interest of our North American mountain domain and its claim to protection from spoliation.

[1]Published by Dodd, Mead & Co., 1922

SPIDERS AS FISHERMEN

BY

E. W. GUDGER*



A spider, probably a *Dolomedes*, that has attacked a minnow and is retaining its hold notwithstanding the fact that the fish is twisting in the hope of ridding itself of its tormentor. The picture is reproduced from a drawing that was prepared under the supervision of Dr. Henry C. McCook, the distinguished arachnologist, from a sketch of the phenomenon made by Professor Edward T. Spring, an eyewitness of the occurrence and the first to record an encounter of this character

IT IS a fact well known to naturalists in general and to fish culturists in particular that many insects, either in the larval or the adult stage, feed on young fishes. This habit is common to some of the larval forms of the dragon flies, or darning needles. It is also known that the water beetle *Hydrophilus* and water bugs of the family Belostomidæ are prone to enriching their diet with young fish. Furthermore it is a matter of general knowledge that the giant bird-catching spider of South America—a representative of a class not far removed from the insects—owes its ominous name to its practice of catching small birds. But that spiders catch and presumably devour little fishes is certainly a phenomenon unknown to most of us. At any rate it would be a hidden or relatively unknown thing were it not for the fact that in the vast literature of fishes and fishing brought together in the *Bibliography of Fishes*, of which I have been for three years associate editor with Dr. Bashford Dean, there are some references to this phenomenon. The first account led to the finding of others, and it is believed that all the known references are here brought together.

The first account is from the pen of Professor Edward T. Spring of Eagleswood, New Jersey, and dates back to 1859, nearly two thirds of a century ago. His account is the most circumstantial of those to be quoted and will be given here in full.[1]

[1]Spring, Edward A. [Letter regarding a fish caught by a spider]. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1859, Vol. XI, p. 255.

*Associate in Ichthyology, American Museum

"I was over on the South Amboy [New Jersey] shore with a friend, walking in a swampy wood, where a dyke was made, some three feet wide, when we discovered in the middle of this ditch a large black spider making very queer motions for a spider, and on examination it proved that he had *caught a fish.*

"He was biting the fish, just on the forward side of the dorsal fin with a deadly gripe, and the poor fish was swimming round and round slowly, or twisting its body as if in pain. The head of its black enemy was sometimes almost pulled under water, but never entirely, for the fish did not seem to have enough strength, but moved its fins as if exhausted, and often rested. At last it swam under a floating leaf at the shore, and appeared to be trying, by going under that, to scrape off the spider, but without effect. They then got close to the bank, when suddenly the long black legs of the spider came up out of the water where they had possibly been embracing the fish, reached out behind and fastened upon the irregularities of the side of the ditch. The spider then commenced tugging to get his prize up the bank. My friend stayed to watch them while I went to the nearest house for a wide-mouthed bottle. During the six or eight minutes that I was away, the spider had drawn the fish entirely out of the water, when they had both fallen in again, the bank being nearly perpendicular. There had been a great struggle—and now on my return, the fish was already hoisted head first more than half his length out on the land. The fish was very much exhausted, hardly making any movement, and the spider had evidently gained the victory, and was slowly and steadily tugging him up. He had not once quitted his hold during the quarter to half an hour that we had watched them. He held, with his head toward the fish's tail, and pulled him up at an angle of 45° by stepping backwards. How long they had been there or how far they had come we cannot tell. We saw no web anywhere about.

"The time would not permit a longer stay, so we reluctantly bottled the pair. I thought I had missed dipping up the spider, and looked along the bank, but on turning to the bottle he was there. The fish was swimming weakly at the bottom of the water that I had dipped in, and the spider standing sentinel over him on the surface, turning when he turned, and watching every motion. We stopped the mouth of the bottle so that the spider could not escape, and went to see the fine place of the late Mr. Stevens above on the hill. Returning in about three hours, we found, to our disappointment, the spider dead at the bottom, but the fish was alive. He lived for twenty-four hours. The spider was $\frac{3}{4}$ of an inch long, and weighed 14 grains; the fish was $3\frac{1}{4}$ inches long and weighed 66 grains."

The next recital is by Mr. T. M. Peters[1] of Alabama. It was communicated to the Smithsonian Institution and by it forwarded to *The American Naturalist* in which it was published in 1876. Mr. Peters says:

"Just before the late war I was at Col. Oakley Bynum's spring, in Lawrence County, Ala., near the town of Courtland where I saw a school of minnows playing in the sunshine near the edge of the water. All at once a spider as large as the end of my finger dropped down among them from a tree hanging over the spring. The spider seized one of the minnows near the head. The fish thus seized was about three inches long. As soon as it was seized by its captor it swam round swiftly in the water, and frequently dived to the bottom, yet the spider held on to it. Finally it came to the top, turned upon its back and died. It seemed to have been bitten or wounded on the back of the neck near where the head joins. When the fish was dead the spider moved off with it to the shore. The limb of the tree from which the spider must have fallen was between ten and fifteen feet above the water. Its success shows that it had the judgment of a practical engineer."

In 1885, Dr. Henry C. McCook met Professor Spring at Chatauqua, New York, and had from him by word of

[1]Peters, T. M. "A Spider Fisherman." *The American Naturalist*, 1876, Vol. X, p. 688.

mouth a detailed account of the observations first quoted. Professor Spring also drew for Doctor McCook a sketch of the attack of the spider on the minnow. In his *American Spiders and Their Spinning Work*, published in 1889, this distinguished arachnologist, after discussing the general untrustworthiness of the commonly printed and circulated accounts of the attacks by spiders on such small vertebrate animals as birds, rats, snakes, etc., reprints Professor Spring's account *in extenso*, on pp. 235-36 of Volume I of his work, giving it his full credence. Furthermore, he had Professor Spring's sketch worked up by an artist and reproduced it in connection with the account. Doctor McCook thought that the spider in question was a *Lycosa*, a wolf-spider, or more probably a *Dolomedes*. In this sketch, which is reproduced at the head of this article, the spider and the fish seem rather large in comparison with the size of the near-by lily pads.

Doctor McCook's rendition of Professor Spring's most interesting observation, is referred to on page 603 of Prof. J. H. Comstock's *Spider Book* published in New York in 1912. Professor Comstock agrees that the spider was probably a *Dolomedes*.

In the third volume of Doctor McCook's monumental work, on p. 66, is a corroboratory account of the above incident. This account seems to have escaped the attention of most students. Doctor McCook says:

"The case [above cited] has excited much interest, and it is gratifying to have it supported by a like well authenticated instance. Mr. Francis R. Welsh, of Philadelphia, writes me that a spider once killed two sun-fish, each about two inches long, that he had in a basin in his room. After having attacked the first fish it ran over the water and fastened upon the second, which was also at the time apparently well and vigorous. Mr. Welsh drove the spider off, but the fishes died in a few hours."

The next account to be given comes from nearer home. Mr. William T. Davis[1] of Staten Island, an enthusiastic member of the New York Entomological Society, writes that with some friends he was on May 10, 1890.

". . . rambling among the innumerable little hills near Grasmere Station, on Staten Island, and in the late afternoon came to a small, wood-shaded pond. Several moderately large spiders were on its surface, a few feet from the shore, and it so happened that while I was watching one of them, in particular, that rested quietly, it suddenly made a rapid motion and seized a little silvery fish over an inch in length. It held it firmly and remained as stationary as it had been before the capture. A number of water-beetles (Gyrinidæ) now came swimming about the spider, no doubt being anxious to share in the feast, but they quickly decamped upon the approach of the water-net that captured the Arachnid."

Mr. Davis positively identified the spider as a *Dolomedes*, and I understand, has at the present writing both spider and fish in his collection.

The next observation was made by Dr. Thomas Barbour,[2] of the Museum of Comparative Zoölogy, Cambridge, Massachusetts, in southern Florida in the spring of 1921. He was fishing in the upper St. Johns River in a very swampy region when the following incident occurred:

"The vegetation swarmed with Dolomedes, but then these spiders always seem to have a predilection for creeping about on the floating lettuce, especially. The water, both beneath the plants and in the little open spaces between them, teemed with several species of cyprinodont fishes, of which a Gambusia, beyond doubt affinis, was the most abundant. . . . A tiny flash of silver caught my eye, and I looked again, to see a spider carrying a small dead fish, perhaps an

[1]Davis, William T. "A Spider Fisherman." *Entomological News*, 1891, Vol. II, p. 77.

[2]Barbour, Thomas, "Spiders Feeding on Small Cyprinodonts." *Psyche*, 1921, Vol. XXVIII, pp. 131-32.

inch long, across a wide leaf to the dark interior of a large lettuce cluster. I thought that probably the spider had found a dead fish by chance and I relit my pipe, when about six feet away in another direction the episode was repeated. This time the little fish was still struggling feebly in the spider's cheliceræ. Later I saw a third fish being carried off which was dead and quite dry."

The account now to be given does not refer to the catching of a fish but of a frog in the tadpole or fish stage; however, it is so pertinent and so interesting that it is quoted herein. It is by the well-known Argentine naturalist, Carlos Berg.[1] He identifies the spider as *Diapontia kochii*, one of the Lycosidæ, a vagrant given to living in certain definite localities at certain seasons of the year. His observations on this remarkable habit were made on two female specimens. He says of *Diapontia:*

"In spring it lingers on the shores of small streams and ditches, where it makes its home. This consists for the most part of a more or less horizontal hole or cavity, lined with a comparatively firm silken tissue which projects out in the shape of a funnel. Not only does it catch its prey of passing insects and spiders from the door of its cavity, but also goes out in order to search about, and, what seems most surprising, to fish. The object of its fishing is for no less than tadpoles, those swift and slippery larval frogs. But the spider knows how to set up its apparatus and how to take its precautionary measures, in order that the toothsome morsel may not escape her. On the surface of the water, usually upon or between stones, where the tadpoles are wont to sun themselves, the spider constructs a two-winged or funnel-shaped net, a portion of which dips into the water, particularly after a rainfall, which swells the waters of the brook. The tadpoles, without suspecting the cunning of the spider, venture into the net-like wing of the tissue or its funnel, and the spider skimming from behind upon the water drives them on and finally overcomes one that has ventured deeper into the net. The shrivelled-up tadpole-skins surrounding the net convinced me of the skillfulness of the spider as a fisherman."

[1]Berg, C. "Eine fischende Spinne." *Kosmos*, Zeitsch. f. Entwickelungslehre u. einheitliche Weltanschauung, Stuttgart, 1883, XIII Bd., p. 375.

Although more than one of the observers above cited convey the impression that the spider devours its strange prey, one eminent authority at least, Professor Alexander Petrunkevitch, of Yale University, raises question, in a letter addressed to the present writer, whether the fish captured serves as food:

"May I add that I am a little in doubt of the possibility of spiders using fish as food for the reason that spiders predigest their food by injecting the secretion of the maxillary glands into the wound inflicted by the fangs. This fact has been demonstrated by various observers and is beyond any doubt, at least in the case of spiders feeding on insects. It has been suggested that Tarantulae may at times feed on small birds but even that is considered to be doubtful. This does not mean that a spider cannot kill a bird or a mouse or a fish, as it has been observed on various occasions, but it is not likely that any vertebrate is ever used by spiders as food."

NOTES

ASIA

THE FAUNTHORPE INDIAN EXPEDITION OF 1923—An important expedition, headed by Col. J. C. Faunthorpe, an A. D. C. to King George and a resident commissioner in Lucknow, India, and Mr. Arthur S. Vernay of New York and London, will devote six or seven months to securing rare and representative animals in different parts of India, with a view to establishing in the American Museum a collection from that part of the world that may be commensurate with the importance and interest of its fauna. The expedition, which is made possible through the generosity of Mr. Vernay, will include a native bird collector, a taxidermist (Mr. John Jonas), a moving-picture operator, equipped with an Akeley camera and 25,000 feet of film, and native helpers to the number of thirty or more.

Mr. Vernay, who is at present in London, will sail shortly for Bombay and will be joined by Colonel Faunthorpe in Lucknow. They will proceed at once to the northern part of Nepal in the foothills of the Himalayas where they hope to obtain, in addition to a group of tigers in their winter coat, specimens of the great one-horned rhinoceros and of the sloth bear.

A tiger hunt in this region is full of picturesque interest. Natives are sent out at about six o'clock in the morning to ascertain whether there are any fresh traces of tiger. They return with their reports and if these reports are favorable, the party sets out. The gunners, of whom there are four, are mounted on elephants and, in addition, many other elephants are used as beaters and also to allay the suspicion of the tiger, accustomed as that animal is to the presence of the huge pachyderms. The herd proceeds through the thick jungle grass. At intervals the elephants trumpet and strike their trunks on the ground, while the hunters sit silent and vigilant, waiting for the moment when the tiger shall appear, probably not more than fifty yards from the beat. As the tiger rushes out, the gunner in whose direction it is leaping shoots, while the others hold their fire. Marksmanship, under such circumstances, is not easy, for the restlessness of the elephant interferes with the steadiness of the aim, and the tiger with a challenging "whoof" covers the ground swiftly with great bounds. When the animal has been laid low by a well-directed shot and has been skinned, the sharp-eyed vultures gather and in an incredibly short time devour the carcass.

In the thick grass that conceals the tiger lives also the pink-headed duck, another desideratum of the expedition, and to drive it out of its cover reliance will have to be placed on the beating elephants.

From the foothills of the Himalayas the expedition will move southward to collect from one area specimens of the swamp deer, and from another black buck, sambar, and chikara.

The gaur or Indian bison—not to be confused with the Indian buffalo, of which specimens will also be collected—is the principal objective of the hunt in the district of Mysore. This spectacular animal attains a height of about six feet at the shoulders. Unlike the buffalo, it has never been domesticated, bred, or kept in captivity. It is hoped that, with the consent of the Maharajah of Mysore, an Indian bull elephant and a cow elephant may be secured in this district.

The Gir Junagarh Forest, north of Bombay, is the only region in India where the lion is found, and it is there that, subject to the approval of the Viceroy, the expedition will hunt the king of beasts.

Although the animals mentioned are particularly desired and will be the special object of search, the expedition will endeavor to secure specimens also of the cheetah, the kakar or barking deer, the wild boar, wolves, jackals, wild dogs, monkeys, civet cats, hyenas, as well as the smaller mammals, birds, and reptiles. No efforts will be spared to obtain a representative collection of animals, which arranged in habitat groups and placed in the prospective Asiatic wing of the American Museum will enable visitors to get an impression of the diversity and interest of the fauna of India.

DISCOVERIES IN MONGOLIA.—The Third Asiatic Expedition reports extraordinary success from its summer's explorations in Mongolia. Mr. Walter Granger, palæontologist of the expedition, has secured complete skeletons of small Cretaceous dinosaurs, a skull of the giant hornless rhinoceros *Baluchitherium*, and numerous other important specimens. The *Baluchitherium* skull is nearly five feet long and the animal equaled or exceeded the largest mammoths and elephants in size. A series of important fossil-bearing formations of Cretaceous and Tertiary age has been found, with very extensive exposures, which may take years to explore. This "opens up a new field in vertebrate palæontology," as Mr. Granger justly remarks, for no fossil vertebrate remains other than part of a rhinoceros jaw had previously been known from Mongolia, and except for some rather fragmentary specimens from India, dinosaurs had never been discovered anywhere in Asia.

The especial importance of a knowledge of the geological history of the animals of Central Asia has been pointed out by Prof. Henry Fairfield Osborn in an article in the September number of *Asia*, and is further discussed by Dr. W. D. Matthew in a forthcoming number of the same magazine. The great continent of Asia north of the Himalayas is, as the map shows, the central portion of the land areas of our globe. This region, hitherto a blank page in our records, now bids fair to provide us with a great series of extinct faunas, which will throw light upon the sources of the various races of land animals that have successively invaded the outlying continents. Ultimately we hope that it may disclose important evidence bearing upon the ancestry of man, the most interesting of all the problems with which the palæontologist has to deal but, owing to the scanty evidence, one of the most obscure and difficult. No new discoveries directly bearing upon this problem have as yet been reported by the Third Asiatic Expedition, but the extensive fossil fields discovered hold out bright prospects for further exploration.

ANTHROPOLOGY

Objects Recovered Near Taltal.—The American Museum has recently acquired from Mr. P. L. Tommen a collection of about 1700 objects that Mr. Tommen, with the aid of another man, dug from sand mounds near Taltal in the rainless area along the coast of Chile. The objects represent four different culture levels. Not far below the surface but at varying depths, owing to the shifting of the wind-blown sands, the first level was encountered, from which were unearthed objects belonging to a people later than the Inca; further digging revealed an Inca level, and below this yet another level representing pre-Inca culture. Finally the lowest level, and the one of greatest interest, was reached, where only implements of stone were found associated with the interred mummies. These mummies were lying extended at full length, differing markedly in this respect from the mummies of the three upper levels, which were placed in a sitting position with knees raised to the level of the chin. Mr. Tommen states that the mummies of this Palæolithic level are all of the dolichocephalic type; his excavations thus furnish additional support to the generally accepted opinion that the earliest inhabitants of the coasts of Peru, Chile, and Brazil, were long-headed people who had no knowledge of metals and used only very crude implements of stone, bone, and shell.

Dr. P. E. Goddard's Trip to the Northwest Coast.—During the years 1897-1903 the Jesup North Pacific Expedition, financed by President Morris K. Jesup and directed by Professor Franz Boas, did systematic research on the Northwest Coast of America and the Northeast Coast of Asia. Large collections were secured for the American Museum by the expedition, which were added to those made previously by Lieut. George T. Emmons, Mr. Heber R. Bishop, and others. The American specimens are arranged in the Jesup North Pacific hall, the care of which through successive staff changes has devolved upon Dr. P. E. Goddard. In order to give more efficient care to the hall and its labels, and more particularly in order to prepare a handbook of the Northwest Coast tribes, Doctor Goddard visited the coast of British Columbia and Alaska last summer. The first part of the trip was made in the company of Dr. C. F. Newcombe, long recognized as an authority upon the tribes of that region. At Sitka among the Tlingit he had the assistance of Lieut. George T. Emmons, who has been engaged in researches regarding this people for many years. In several of the Indian villages visited, especially at Alert Bay and Sitka, native life was seen in progress. About 1500 feet of moving picture film showing industries and handicrafts were secured. Negotiations are now under way for the purchase of carved posts as additions to the Northwest Coast hall of the American Museum.

A Gift of a Scarf.—The American Museum is the recipient of many gifts of specimens from those who wish in that way to evidence their faith in the purposes to which the Museum is dedicated. At times these gifts are handed over by the donors under circumstances which enable one to gauge the extent to which the Museum's exhibits have captivated the interest of those who have strayed within its halls. As an instance, there recently entered the office of the curator of anthropology a Greek bearing a scarf which he said he wished to present to the institution. The scarf had been brought from the Kurd district of Turkey by the donor's brother, who had been impressed into the Turkish army but subsequently had been released. The Greek in handing over the scarf said that through this gift he wished to show his appreciation of the exhibits which he had enjoyed on previous visits to the Museum.

AMPHIBIANS AND REPTILES

The Heilprin Expedition to Santo Domingo.—Doctor and Mrs. G. Kingsley Noble, of the American Museum, who set sail in July for the island of Santo Domingo, have just returned to New York. Their purpose in visiting the island was primarily to secure materials toward the construction of two groups for the new hall of reptiles.

The fauna of Santo Domingo is unique. Not only the largest tree frog in the world, but also the heaviest (if not the longest) lizard in the Americas, live on that island. Doctor and Mrs. Noble have brought back with them a large series of specimens of these two creatures, hitherto extremely rare in collections, and accessory material to be used in the reproduction of their habitats; they also were fortunate enough to work out the life histories of both animals, about which little or nothing was previously known.

The expedition was made possible through friends of the Museum, and was called the Angelo Heilprin Expedition to the Dominican Republic. Thanks to the coöperation of the Marine Corps and the Guardia Nacional Dominicana, the expedition crossed the entire length of Santo Domingo in a very short time and was able to investigate fully localities which have never before been visited by naturalists.

The expedition went prepared to make permanent record of the behavior of the animals encountered, and one of the outstanding results is the collection of flashlight portraits of tropical frogs. By the aid of extra-fast flash powder, frogs have been snapped while in the act of singing, caring for their eggs, and making their way through the jungle, wholly unaware that they were being observed.

The life histories of practically all of the Amphibia of Santo Domingo were investigated, and the eggs and young of a large proportion of the species secured. Several new types of breeding behavior were observed. It was found that the giant tree frog lays its eggs among stones near the mountain torrents, and the tadpoles which hatch out are adapted to life in the rushing current. They are equipped with an adhesive apparatus which enables them to hold on to bowlders in mid-stream. The expedition furthermore ascertained that the giant tree frog, in spite of its great adhesive toes, was not entirely arboreal in its habits, but was very fond of resting for hours on moss-covered bowlders near the mountain torrents, where the atmosphere and vegetation were saturated by the mists which arose from the falls.

The rhinoceros iguana is restricted to the arid southwestern portions of Santo Domingo. Along the edge of Lake Enriquillo, a salt lake more than 130 feet below sea level, this great saurian was found fairly abundant. It digs burrows in the banks of dry ravines and sallies forth only during the heat of the day. The expedition secured alive more than fifty iguanas. These were captured by means of dogs. The biggest iguanas, however, would often break through even the largest pack of dogs employed and in such cases it was found necessary to shoot them and prepare their skins in the field. The expedition was very fortunate in finding the eggs of the iguana just at the time they were hatching. These were laid in sandy pockets, generally more than a foot below the surface. The eggs are white, about the size of a hen's egg, but with a soft shell. The iguanas which hatch out sometimes carry their shells with them to the surface, and it was through the finding of these empty shells that the breeding sites of the iguanas were first discovered.

VERTEBRATE FOSSILS

Reconnoissance and Collecting in Nebraska.—The Nebraska Field Expedition of the American Museum, in charge of Mr. Albert Thomson, spent the season of 1922 collecting in the Snake Creek and Agate quarries in western Nebraska. Dr. W. D. Matthew joined the expedition for a part of the season and with Mr. Childs Frick made a general reconnoissance of the formations to the north and south of the quarries as far as Pawnee Buttes, Colorado. A careful study of the stratigraphy and fossils of the Snake Creek quarries shows that three distinct geological horizons are represented, from each of which large collections of fossil mammals have been secured. The collection made this year is chiefly from the oldest of the three horizons, from which comparatively little material had hitherto been obtained. It includes a few good skulls, several hundred upper and lower jaws, and innumerable teeth and bones, chiefly of three-toed horses, but including also camels, deer antelopes, various Carnivora, and rodents. Many of the species are new or little known, and the comparison of this fauna with the two that succeeded it at this locality will enable us to trace a number of races of mammals through these three successive stages in their evolution, with the aid of a very large amount of material to show the range of variation at each stage in their progress. Such abundant evidence enables the student of evolution to draw sound and definite conclusions as to the true history of the evolutionary changes in the several races of animals the record of which is thus inscribed in the rocks.

BIRDS

Birds of the Azores and Cape Verde Islands.—The department of ornithology of the American Museum has recently profited through field work conducted in the Azores and the Cape Verde Islands by Mr. José G. Correia, of New Bedford, Massachusetts. Mr. Correia, who is a native of Fayal, in the Azores, accompanied Dr. Robert Cushman Murphy on the South Georgia expedition of 1912 and 1913. He was at that time a member of the crew of the whaling brig "Daisy." Because of his innate interest in natural history he developed into a competent collector, and during the years since that time he has made several voyages in the interests of ornithological science.

The material which has been received from the Azores and Cape Verde Islands comprises several hundred specimens, and is particularly rich in marine birds. One species of gull has proved to be a new geographical race, and has recently been described in the *American Museum*

Novitates by Dr. Jonathan Dwight as *Larus fuscus atlantis*. It is apparently the resident form at the eastern Atlantic islands of a widely distributed northern gull. Among the other birds are no less than five species of petrels, as well as splendid series of boobies, tropic birds, and some of the rare insular species of land birds.

To accompany his collection of specimens, Mr. Correia has prepared an interesting account in Portuguese regarding the life histories of the birds and concerning the islands which he visited. This information will of course add very materially to the value of the published results.

Lecture by Dr. R. C. Murphy.—At the intermonthly meeting of the Geographic Society of Chicago, held on Friday, October 27, Dr. Robert Cushman Murphy, associate curator of marine birds, American Museum, delivered a lecture on "The Way of the Sperm Whaler," in which he drew upon his experiences in hunting the whale with harpoon, hand lance, and other tackle during a sixteen-thousand-mile voyage in the brig "Daisy."

FIRE PREVENTION WEEK

Asbestus Exhibit.—Fire Prevention Week, October 2–9, was signalized at the American Museum by the installation of an exhibit of asbestus and articles showing some of the uses to which this important fire-resisting material is applied. The asbestus of commerce is the chrysotile of the mineralogist and is a delicately fibrous form of serpentine. It occurs in veins in massive serpentine in the Archæan rocks of the Province of Quebec and the state of Arizona, where it is extensively mined or quarried for technical purposes. It is not confined, however, to these localities. The mineral of long uniform fiber is carded, spun, and woven into cloth, which is used for the making of theater fire-curtains, clothing, mittens, etc. The mineral of shorter fiber is likewise separated into its component threads and used in the making of fire-proof boards and shingles and other roofing materials, as well as for an insulating covering for boilers, steam pipes, and the like. The material forming the exhibit was very kindly lent and installed by the Johns-Manville Company.

THE CENTENARY OF LOUIS PASTEUR

December 27, 1922, will mark the one hundredth anniversary of the birth of Louis Pasteur, founder of the science of bacteriology, at Dôle, Department of Jura, France. Pasteur was graduated in 1847 from the École normal in Paris, as a chemist and mineralogist, and early in 1849 became professor of chemistry in the University of Strassburg. His eminent work led to his election in 1862, at the age of forty, as a member of the section of mineralogy in the Académie des Sciences. His great work for the deliverance of man from plague and pestilence was accomplished in the period following this appointment to the time of his death in 1895.

The members of the New York Mineralogical Club felt that so historical an event as the centenary of Pasteur's birth should be fittingly celebrated in New York. Accordingly at he meeting of the club last May President George F. Kunz was empowered to arrange the details. As a fruition of this plan the auditorium of the American Museum will be the scene of a great meeting on the evening of December 27, which will be held in coöperation with specialists in the lines in which Pasteur made his greatest discoveries. The Hon. Henry Cantwell Wallace, Secretary of Agriculture, has expressed his willingness to attend, unless prevented by affairs of state, and the newly elected senator from New York State, Dr. Royal S. Copeland, has also signified his intention to be present.

In addition to the meeting it is proposed to hold an exhibition designed to illustrate the great contributions of Pasteur to science. It was his observations on the ferments of beers and wines which paved he way for his studies in the bacteriology of disease. Of the greatest importance to French industry was his discovery of the causes of the silkworm's disease, which threatened the silk production of that country, and his indication of a specific for its prevention, the successful use of which restored the industry to its former prosperity. Cholera in fowls next engaged his attention, followed by his investigation of anthrax in cattle. Both of these scourges were brought under control through his researches. Of even more far-reaching importance to human welfare was his discovery of the antitoxin for hydrophobia.

As part of the exhibit, will be presented illustrations of the treatment of the ferments in milk which has led to the method denominated "Pasteurization."

One of the earliest triumphs of Pasteur's investigations was the interpretation of the different behavior of two tartaric acids, one of which turned to the right the plane of a ray of polarized light, while the other remained inoperative. The inactivity of the second acid was due to the fact that it was composed of two isomeric constituents diverting the rays in opposite directions. The original model of a tartaric acid crystal, eight inches high, used in Pasteur's class lectures, and bearing a label in his own handwriting, will be shown. This model, together with a remarkable glass case containing objects of equal interest relating to Curie, Lister, and others, was presented to the Medical Museum of the University of Pennsylvania by Dr. Robert Abbe of New York.

The centennial will be independently celebrated by the New York Academy of Medicine, of which Dr. Charles L. Dana is president, on December 27, and there will be a memorial meeting on January 10, 1923.

A festival in honor of the Pasteur centenary will take place in Strassburg under the auspices of the University where he occupied the chair of chemistry. On June 1, 1923, a monument to his honor will be unveiled at the Place de l'Université. Another phase of the festival will be the creation of the Museum of Hygiene designed to commemorate his discoveries, and to illustrate the development of the science of bacteriology. A special exhibition, designated as that of the Pasteur Centenary, is to show objectively all the consequences of his work in the departments of medicine, of hygiene, of industry, and of agriculture. This exhibition will be inaugurated on June 1, 1923, by President Millerand of the French Republic, assisted by members of the Ministry and of the Parliament, as well as by numerous scientists of France and of other nations.

A beautiful acknowledgment of Pasteur's worth and moral greatness is given by Professor Henry Fairfield Osborn in his little book *The New Order of Sainthood*.[1] He queries whether we ought not to found a new order of Sainthood for men like Pasteur, and asks whether a statue of Louis Pasteur in the Cathedral of St. John the Divine would not proclaim the faith of the modern church that the two great historic movements of love and knowledge are harmonious parts of a great and eternal truth.

ENOS A. MILLS

Enos A. Mills, who died on September 21, at Longs Peak Inn in the Rocky Mountains National Park, was born in the plains region of the Middle West, but it is with the wonderland of the Rockies, with the frost-scarred peaks of his beloved Colorado, that his memory will be enduringly associated. Long before the Government took steps to establish as a national park the region to which Estes Park is the portal, Mills had fallen under the spell of its attraction. His lone cabin, erected in 1886 at the foot of Longs Peak—the majestic mountain that dominates the Park from its altitude of more than 14,000 feet—in time gave place to the commodious Longs Peak Inn with its assemblage of cottages, a veritable Mecca for nature lovers from all parts of the country, who found inspiration not only through the more intimate contact with nature afforded by the isolated locality but also in the personality of the man who presided over the Inn and who, through his writings and his addresses, had the faculty of kindling in others the enthusiasms which he felt so genuinely.

In one of his volumes he speaks of the wilderness as "the safety zone of the world," and though many of his adventures were spiced with danger and might easily have terminated unhappily in the case of a less experienced mountaineer, he was throughout master of his environment. Yet he who had raced on skis down the slippery, tree-encumbered mountain-side, pursued by a descending avalanche bent on engulfing him; who had made friends with beasts like the grizzly that most of us stand in awe of even as we gather in front of the iron bars that form its prison enclosure; who had been snow-blinded when alone on the summit of the Continental Divide and forced to feel his way with his staff, in peril of stepping off a cliff or walking overboard into a cañon—succumbed ultimately to injuries sustained in a Subway accident during a visit to New York.

Enos Mills preached the gospel of the love of natural things and exemplified his teachings in his life. He pleaded for the protection of wild animals—even those which we regard with a fear that is genuine but immoderate. He knew from his intimate contact with nature and the fellowship it engenders that a dead trophy is not comparable in inspirational value with the memory of a close-up observation of a living animal that has lost its fear of man.

NEWS FROM KARTABO

The amazing diversity of animal life in certain regions where man and his innovations have not challenged the dominion of nature is well illustrated by the results which Mr. William Beebe, director of the Tropical Research Station of the New York Zoölogical Society, has obtained. Working intensively over a "quarter mile of jungle and shore," Mr. Beebe has secured within this little patch no less than 717 species of vertebrates. Among his recent acquisitions one of the most interesting is a giant armadillo, which is to be sent to the American Museum. Not only were anatomical notes regarding this creature made at Kartabo, but a colored plate of it was prepared by Miss Isabel Cooper, the artist attached to the Station, whose paintings of tropical animals are records as valuable in their way as the specimens themselves.

Real excitement attended the capture of a great anteater, which took possession of Mr. Beebe's boat and forced the rightful occupants into the water. Motion pictures of this spirited incident were fortunately secured and will serve as a record of the formidable vigor of this animal, which is to be shipped to the New York Zoölogical Park.

[1] *The New Order of Sainthood*, by Henry Fairfield Osborn, New York, MCMXIII. 8vo., 17 pp.

PAN-PACIFIC SCIENTIFIC CONFERENCE

The Pacific Ocean covers a surface of 55,000,000 square miles, the equivalent of the entire land area of the globe, and the countries that border it and the islands that are scattered over its vast expanse present a diversity of problems that can be solved only through the coöperative effort of many trained minds. It was "to outline scientific problems of the Pacific Ocean region and to suggest methods for their solution; to make a critical inventory of existing knowledge, and to devise plans for future studies" that the First Pan-Pacific Scientific Conference was held at Honolulu, Hawaii, from August 2-20, 1920, presided over and directed by Dr. Herbert E. Gregory, Silliman professor of geology at Yale University. The papers presented, grouped according to subject matter, with stenographic reports of the discussions that they evoked have been published in three volumes, wherein are also contained the list of committees, the calendar of proceedings of the general sessions and of the sections, an alphabetic list of the delegates attending, and the resolutions adopted.

No one glancing over these volumes can fail to be impressed by the magnitude of this seemingly diverse yet fundamentally interrelated subject matter where the aid of sister sciences must be called upon to solve the special problems confronting each. Dr. Clark Wissler, curator of the department of anthropology, American Museum, who, as leader of the section of anthropology, spoke on "Man in the Pacific," pointed out the service that might be rendered anthropology by data regarding the geological chronology, the fauna, and the flora of the region. "You tell us," said he, "the history (a relative chronology) of such plants as taro, breadfruit, and paper mulberry, etc., and the story of such animals as the pig, chicken, and dog in the islands of the Pacific, and we will soon fill in the gaps in the chronological scheme for the Polynesians."

More intensive study of the fauna and flora of the numerous islands of the Pacific is needed, too, in order to settle the problem of their one-time land connection or their primeval isolation. Are the Hawaiian Islands, for instance, oceanic in origin or continental? The evidence of entomology, as Dr. F. Muir points out in his paper, is overwhelmingly in favor of the oceanic theory, for "the most striking thing about the Hawaiian fauna is the absence of whole groups and the orders present are represented by only a few families, which could have come by flight or by air or ocean currents." On the other hand, Dr. H. A. Pilsbry, from a study of the distribution of the land snails, hazards the opinion that, as evidenced by their homogeneous fauna, the mid-Pacific islands from the Cook group to the Marquesas are the remnants of a fragmented continental mass.

It is in the region of the Pacific that have occurred several of the most cataclysmic volcanic eruptions as well as devastating earthquakes, and it is fitting that so large a space is given over to these subjects. Dr. T. A. Jaggar Jr., who contributed the interesting article on the Hawaiian Volcano Observatory to the issue of Natural History for July-August, 1921, opens the discussion of this division of the problems of the Pacific with "The Program of Experimental Volcanology." In the North Pacific, Dr. G. W. Littlehales points out, there is a tract twice as large as the United States which has been crossed by only a single line of soundings about 250 miles apart, and in other portions of this ocean there are areas as large as Australia that remain entirely unfathomed. One can readily see, therefore, that in the mapping of the Pacific a vast amount of work still remains to be done. Other interesting papers are those grouped under meteorology, ocean currents, the geological mapping of the Pacific, correlations of Post-Cretaceous formations in the Pacific region, and miscellaneous papers on geology.

FOOTBALL—AN ANCIENT GAME

Football may at first thought seem merely the virile ideal of modern adolescent manhood, a special creation of our age. Such is, however, not the case, for though in many respects the sport has undergone specialization and even transformation in more recent times, it is in its essentials of great antiquity; indeed, games of more or less similar character were played by many primitive peoples.

An interesting theory as to the possible origin of football is discussed by E. K. Chambers in the *Mediæval Stage.* According to this theory there were in ancient times scrimmages for the possession of the head of an animal that had been sacrificed. It was thought that such a head, if buried in a field, assured plenteous crops; hence it was a thing worth fighting for. Today the struggle is still waged as keenly as ever but instead of the sacrificial head, there has been substituted a football, the mystic potency of which is limited to the interest its changing fortunes evoke among the players and among the packed rows of frenzied spectators at our big games. It is worth recording in this connection, that the Eskimos about Bering Strait have a picturesque interpretation of the Northern Lights. They speak of the phenomenon as a game played by shades, in which, in place of a ball, the object of contention is the skull of a walrus.

We speak of the football as "the pigskin." In the time of Henry VIII a pig's bladder was used. The English poet, Alexander Barclay, writing in that age, contributes this spirited description:

They get the bladder and blowe it great and thin,
With many beanes or peason put within,
It ratleth, soundeth, and shineth clere and fayre,
While it is throwen and caste up in the ayre,
Eche one contendeth and hath a great delite
With foote and with hande the bladder for to smite,
If it fall to grounde they lifte it up agayne,
This wise to labour they count it for no payne
Renning and leaping they drive away the colde.
The sturdie plowman lustie, strong and bolde
Overcommeth the winter with driving the foote ball,
Forgetting labour and many a grevous fall.

The allusion to "many a grevous fall" is proof that there is time-honored precedent for the violence still incident to this sport. Indeed, as played in the good old days, football was a game so rough and noisy that both Henry VIII and Elizabeth enacted laws against it. Sir Thomas Elyot, writing in 1531, speaks of football as being "nothyng but beastly fury and extreme violence, whereof proceedeth hurte and consequently rancour and malice do remayne with thym that be wounded, wherefore it is to be put in perpetual silence." An even more wrathful denunciation appears in Stubbes' *Anatomy of Abuses*, written some fifty years later, wherein football is referred to as "a devilishe pastime" giving rise to "envy, rancour and malice, and sometimes brawling, murther, homicide, and great effusion of blood, as experience daily teacheth."

Among the American aborigines many different ball games were played and certain of these, in which the ball was propelled by kicking, sometimes supplemented, as among certain of the Eskimos, by whipping with a specially constructed driver, are classed by Stewart Culin in his *Games of the North American Indians* as football. Some of these games were not lacking in violence. Of the game of football played by the Micmac, a writer in *The American Anthropologist*, Vol. VIII, p. 35, relates: "In more recent times a player may catch his opponent by the neck and thus hold him back until he can obtain the ball himself, but scalping was anciently employed as a means of disposing of an opponent." This reference to scalping is no doubt based upon well-known legends in which the player forfeits his scalp to the winner. In the Cherokee ball game, a form of lacrosse, "about everything short of murder" was allowable.

Among the Topinagugim Indians of California rival teams of men and of women participated in a ball game, the rules of which permitted the women to advance the ball with their hands or in a handled basket, while the men could use only their feet to drive the ball toward the goal of their more favored opponents. Among the Crows shinny was played by men ranged against women.

To those who have known the rigors of the training table and the restrictions there imposed, the indulgences of the Menomini lacrosse players will seem strangely at variance with the usual rules of behavior governing athletes. "On the ground," says Mr. Walter J. Hoffman, "a cloth is spread, and on this are placed tobacco, pipes, and matches, to which all the participants are at liberty to help themselves." It has been stated that among the Choctaw, while a ball game is in progress, the women run about and give hot coffee to the players. Their ministrations are not, however, wholly benevolent. "In one hand," we are told, "they carry a cup of coffee and in the other a quirt with which they whip the players when they think they are not playing hard enough."

MEETINGS OF SCIENTIFIC SOCIETIES

The American Ornithologists' Union held its fortieth stated meeting at the Field Museum in Chicago, October 24-6. A list of ninety-eight members whose presence was expected, representing localities scattered all over the United States, Canada, and even Europe had been printed in advance, but this number was exceeded by the actual attendance. Dr. Arthur A. Allen, professor of ornithology at Cornell University, was elected a fellow, a distinction restricted to a total of fifty individuals.

The American Museum was well represented on the program, the following papers being contributed by members of its scientific staff: "Distribution of the Genus *Momotus*," "A Possible Mutant in the Genus *Buarremon*," and "A Summer in Ecuador," by Dr. Frank M. Chapman; "The Whitney South Sea Expedition of the American Museum of Natural History" and "On a Collection of Birds from the Cape Verde Islands," by Dr. Robert Cushman Murphy; "Variations in the Structure of the Aftershaft and Their Taxonomic Value," by Mr. W. DeWitt Miller; "The Vocal Organs of the Prairie Chicken," by Mr. James P. Chapin; "The Rôle of the Bird Census" and "Notes on *Donacobius*," by Mr. Ludlow Griscom; "Remarks on Methods of Measuring Birds," by Mrs. E. M. B. Reichenberger; "Notes on Off-Shore Atlantic Birds," by Mr. J. T. Nichols.

American Society of Ichthyologists and Herpetologists.—The seventh annual meeting of the American Society of Ichthyologists and Herpetologists was held at the Field Museum, Chicago, on Friday, October 27. Mr. John T. Nichols, associate curator of recent fishes, American Museum, read a paper entitled "Notes on the Tunny and Its Relatives." Dr. William K. Gregory, curator of comparative anatomy, contributed an abstract of his paper on "A Middle Jurassic Fish Fauna from Western Cuba, with Remarks on the Adaptive Radiation of the Holostean Ganoid Fishes." Mr. Karl P. Schmidt, until recently connected with the department of herpetology, American Museum, and now in charge of the reptile department at the Field Museum, spoke on "The Distribution of Lower Californian Reptiles." The eighth annual meeting of the society will be held in Cambridge, Massachusetts.

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 6,438.

Patron: Miss Helen Clay Frick and Mr. A. Perry Osborn.

Life Members: Mesdames J. G. Brady, Thomas R. Proctor; Miss Dorothy Bull; Chas. B. J. Mittelstaedt, M. D.; Professor Alfred C. Kinsey; Messrs. Philip De Ronde, Philip L. Goodwin, Hermann Norden, John M. Phillips, and Henry H. Wehrhane.

Sustaining Member: Mr. W. Rodman Fay.

Annual Members: Mother Teresa; Sister M. Charita; Mesdames Samuel J. Broadwell, Harold Brown, W. R. Conklin, Thyrza Benson Flagg, A. G. Gerster, F. Norton Goddard, Harry L. Hamlin, George Frederick Laidlaw, D. McAteer, Charles Mergentime, Martha Doane Reid, Howard Crosby Warren; the Misses Florence Birch, Alice A. Driggs, Harriet Keith Fobes, Jessie Ziegler; the Reverend Dr. A. Edwin Keigwin; Doctors Robert Emery Brennan, Charles J. Dillon, Alice Gregory, E. H. Raymond, Jr.; Messrs. Caleb S. Bragg, George T. Brokaw, J. Wright Brown, Henry R. Carey, Carl B. Ely, William Fahnestock, Charles S. Fayerweather, Wm. A. Fraser, Henry M. Friedman, Walter S. Gifford, Albert Z. Gray, Wm. H. Grueby, Everett B. Heymann, Chas. T. Hindley, Robert A. Jackson, Robert Portner Koehler, C. Lagemann, Charles Otis, Henry Van Riper Scheel, Arthur H. Sleigh, Harry D. West, and the Polytechnic Preparatory School.

Associate Members: Major M. Portal, D. S. O.; Doctors James Chace, Eldridge G. Cutler; Messrs. Geo. Denegre, Luther H. Johnson, Louis Krumbhaar, S. B. Monroe, Tolbert Reavis, James D. Robertson, Elmer G. Spencer, Roscoe J. Webb, and the Department of Geology and Geography, Northwestern University.
