NATURAL HISTORY

THE JOURNAL OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

EDITED BY
MARY CYNTHIA DICKERSON

VOLUME XX, 1920

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

1920

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

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

CONTENTS OF VOLUME XX

January–February

March–April

May–June

September–October

November–December

ILLUSTRATIONS

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

JANUARY–FEBRUARY, 1920

VOLUME XX, NUMBER 1

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VOLUME XX CONTENTS FOR JANUARY–FEBRUARY NUMBER 1

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

Subscriptions should be addressed to the Secretary of the American Museum, 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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NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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PEARY, 1856-1920

Portrait from the bust executed in Carrara marble at Florence by the American sculptor, Couper, and installed in one of the niches in Memorial Hall, American Museum of Natural History, in 1913

The American explorer, Admiral Robert E. Peary, U.S.N. (retired), reached 90° N. latitude on the sea ice, and indicated with an unfurled American flag the location of the North Pole, April 6, 1909, just eleven years ago. His success came after twenty-three years of Polar work, built on a foundation of the successes and failures of more than three centuries of effort by men of different nations

NATURAL HISTORY

VOLUME XX JANUARY–FEBRUARY, 1920 NUMBER 1

Peary

By HERBERT L. BRIDGMAN

PEARY'S life was an epic in two parts: the first of preparation, the second of performance. When the tale is fully told, as it should be in the fullness of time, the world, which has made him one of its foremost and familiar figures, will learn that his was no sudden or erratic ascent like a rocket in the midnight, but a steady upward advance, that unbroken spiral with constant gradient and constant approach to its culmination.

Washington had reached the meridian before he assumed command of the Continental Armies, but his field work among the Alleghenies and in the Ohio Valley beyond, his civil training among the landholders and patricians of the Old Dominion, had given him vision of the future, of the extent and resources of his country, and of the government and institutions necessary for their development. Lincoln had passed his semicentennial before he assumed the great office in which he was to meet death and immortality, bringing to his cares and duties more than a quarter of a century's unbroken and intimate practice among the courts and the politicians of Illinois. And Peary was quite beyond the first flush of young manhood when at thirty he essayed his first adventure from the sheltered Godhavn upon the hitherto untrodden, mysterious ice cap, foretelling that quest which was to occupy and crown the remainder of his active life, projected against a background which had in it every demand of physical and mental endowment, long and arduous training, so that when in 1891, five years later, this daring young lieutenant of the Navy essayed to take up again the challenge of the implacable North, the human composite was complete and effective. "Poets," runs the old adage, "are born, not made." Explorers like Peary are both born and made, or rather, they make themselves by preparation of mind and body which spares nothing, forgets nothing.

Maybe I can set forth Peary more clearly, as certainly more easily, by a few word pictures from the gallery of memory which show the mood and manner of the man, because of their absolute freedom from accessories or from influences of any incident or environment. Of all the things that Peary was not he was never a *poseur*, or possessor of the least trace of affectation. So that all these incidents, like so many others which come thronging to the mind unbidden, are simply the unstudied, living expression of the real man—and there could be no other whether among all the comforts of home and the company of family and friends, or solitary and alone, with only his faithful "huskies," facing all that an Arctic winter might mean, while the ship with all dearest to him was receding from his sight. Perfectly at ease and with every muscle and thought fully controlled, Peary in great trial or in keenest triumph never

Faithfully
Peary

made a scene. He was always master of himself and the situation.

Well do I remember my first sight of the explorer, returned with acclaim, to which the public, still recalling the melancholy scenes of Cape Sabine, only languidly responded. It was on a rainy autumn evening in a rather dingy and dimly lighted, sparsely filled Brooklyn hall, and he was trying to tell his audience something of what he had seen and done: of his winter in a real house at Red Cliff on McCormick Bay, and of his great thousand-mile traverse of the Greenland ice cap, both radical departures as to method and objective from former Arctic field work, a complete reversal and contradiction of everything which had gone before. The usual perversity of inanimate things possessed the lantern slides so that they utterly failed to appear, yet the lecture, "the voice and nothing more," was all that was necessary to demonstrate that a new era in Arctic exploration had arrived, and that this young officer was only telling the first chapter of what might ultimately be the world's greatest story. Who knew to what latitude Greenland might not reach, and now that the "great ice" had been conquered, why might not the trail lead to the Pole itself?

Later, a few weeks, came another and "capacity" Brooklyn audience, and the graphic and illuminating slides were there; then the great Academy was twice crowded to the doors, and children now grown will never forget the day they saw on the stage the ever faithful "Mat" clad in skins, the dogs and sledges and the igloo lights glimmering through the white expanse, as effective a bit of Arctic realism as ever staged. Then began that country-wide tour, to crowded audiences everywhere, which financed the 1892–95 expedition; and through it all, with scientific honors and social attentions, Peary was always the same—concentrated, imperturbable, intent on getting away for the North at the earliest day the next summer.

Six years later he was again ready to leave for the North and another assault on the forces which had baffled him so long. The "Windward," Lord Northcliffe's gift, had left New York a day or two before and for Sydney, where he was to join her, and as he, straw-hatted, in a summer suit, swung on a Broadway uptown car for the Grand Central, with his cheery, "Good luck! Take care of yourself," one would never have believed that was the proper way to say farewell, when it might be the Pole or it might be forever. But that was Peary's way. It was all in the day's work, and it seemed "so like every day" both to him and to Bartlett, even within sight of the goal.

Then came that Fourth of July

Photograph by Peary

Camp on the shore of Allman Bay in which the "Windward" wintered, 1898–99. The flag followed him in his travels for fifteen years and finally waved above the sea ice at the Pole.

The portrait on the page opposite, from an autographed picture which Peary gave to the writer at Eagle Island in 1911, shows the explorer just after he had been given the thanks of Congress (by special act of March 3, 1911) and promoted to the rank of rear admiral in the United States Navy. Peary as an explorer was both born and made, or rather, he made himself by preparation of mind and body, sparing nothing, forgetting nothing

Roosevelt turned and, placing his hand in Peary's, said, "I believe in you, Peary, and I believe in your success." We who were present cherished the auspicious prophecy, and counted it a good omen that it occurred on the deck of the ice-fighter named for the President of the United States

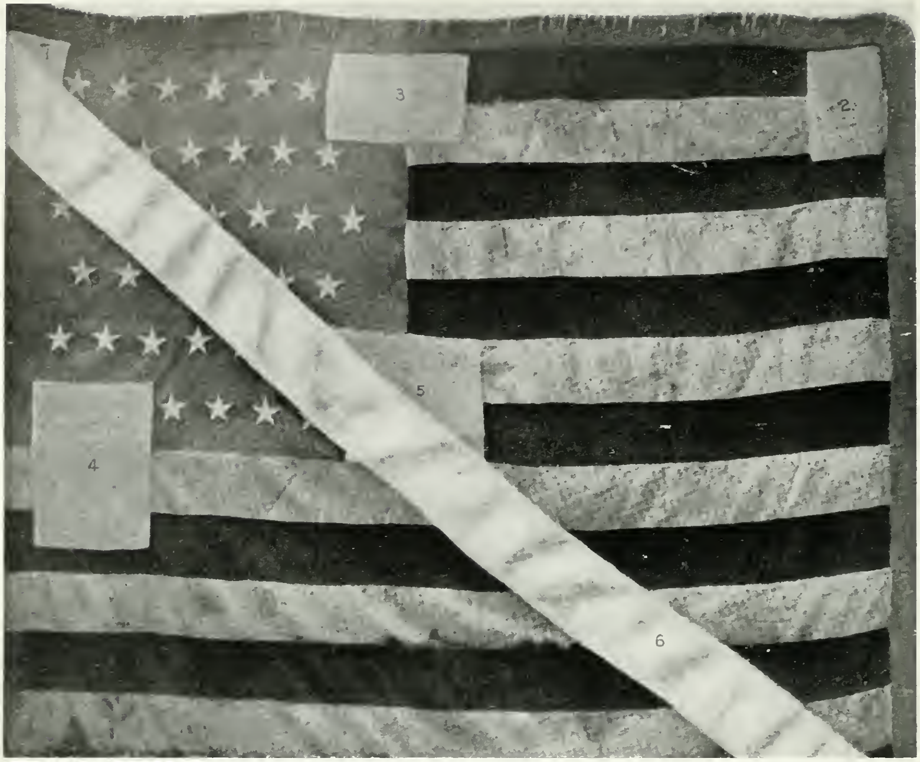
farewell at Oyster Bay when the President of the United States boarded the stanch American ice-fighter bearing his name, accompanied by that gallant son who was later to give his life for his country, "over there." The two men, Peary and Roosevelt, contrasts in some respects, duplicates in others, appreciative and sympathetic, each enjoyed the situation to the full; Peary, that he had the opportunity to put before the President's eyes the men, the ship, and the equipment which meant so much to him and to his country; and Roosevelt, eager as a boy and with his enthusiasm for adventure and discovery aflame, allowed nothing to escape his inquiry and comment. As, after inspection of everything above and below, and, going over the side, he turned and, placing his hand in Peary's, said, "I believe in you, Peary, and I believe in your success," we all counted it a good omen, and cherished his auspicious prophecy.

The great naval parade up the Hudson in October, 1909, a feature of the Tercentennial Celebration, was a bitter, trying day for Peary, but one which showed—what all his friends knew—of what stuff he was made. Some timid souls had even gone so far as to urge him to decline the committee's invitation to place the "Roosevelt," bearing the North Pole flag, at the head of the column, but having accepted, nothing could deter or swerve him, and although the faster steamers outfooted her, she kept her place and made the complete journey with colors flying. Occasionally a taunt or challenge would come over from some insulting, impertinent crowd of excursionists, but Peary would not suffer a word in answer. "It does them more harm than it does us," he said calmly, as he stood in full view on the quarterdeck.

Peary was ever himself, the same in the North or at home, meeting or parting. He met you with a smile and said good-bye with the lighted eye which means "We shall meet again." When he went over the side of the "Falcon" that August morning in 1894, leaving wife and year-old daughter homeward bound in the cabin below, every hand was cordially grasped with a cheery good-bye, and the stalwart huskies bending to the oars, we soon saw him a mile away, erect in the stern of the boat, her white sail drawing full and signaling to us, "Good luck and safe voyage." If any one thought of a winter of torture and a year of privation, it was certainly not the commander, who remained to face them while all the rest of his party, but one, retreated to home and safety. When the "Diana" rounded Sunrise Point, that steep, rocky promontory which thrusts itself into the sheltered, landlocked harbor of Etah, one bright August morning in 1899, her company saw an erect, blue-clad figure holding an improvised staff from which floated straight out into the glittering sunlight the Stars and Stripes, and none needed glasses, or to be told twice, that Peary and the flag were still there. And when, two years after, the "Erik," in summer snow storms pushed her way through the same waters to the anchorage of the "Wind-

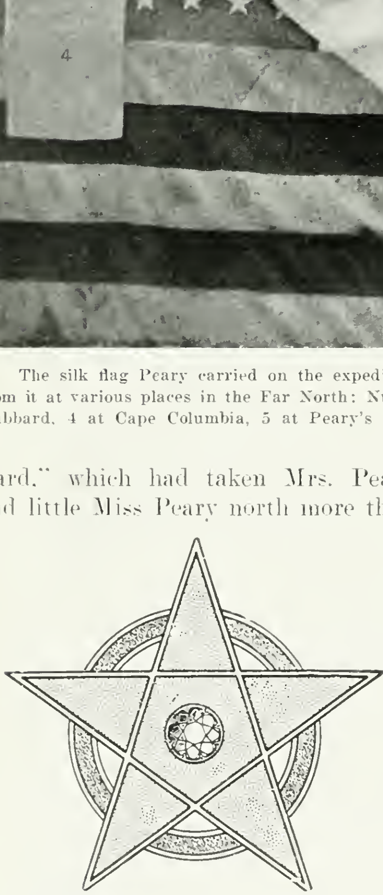
Courtesy of Brown Brothers

Peary was ever himself, the same in the North or at home, meeting or parting. He met you with a smile and said good-bye with the lighted eye which means "We shall meet again"



The silk flag Peary carried on the expedition that reached the North Pole.—He cached pieces cut from it at various places in the Far North: Numbers 1 and 2 at Cape Morris Jesup, 3 at Cape Thomas Hubbard, 4 at Cape Columbia, 5 at Peary's "Farthest North," 87° 6', and 6, on the ice at the Pole

ward," which had taken Mrs. Peary and little Miss Peary north more than



The medal of honor presented to the discoverer of the North Pole by the Peary Arctic Club on the third anniversary of that great event bore the inscription of five of Peary's achievements: "The Crossing of Greenland, 1892"; "Securing the Great Meteorites, 1897"; "Insularity of Greenland, 1900"; "Farthest North, 1906"; "North Pole, 1909"

Duty, honor, country—these made Peary's living motto. Science and patriotism fed the flame of his ambition, and on that eventful day in 1909 when he reached the Pole, it was the flag of America which proclaimed the victory

a year before, we made out the flag of our country flying, even before we could see a sign of life on the ship.

A month later, when, after cruising among all the Eskimo settlements and gathering equipment for the next spring's attack on the Pole, we had been obliged to desist from an attempt to land Peary and his party at Cape Sabine and to put them ashore in an improvised camp on Herschel Bay, he accompanied the last parting grasp of the hand as the ship's propeller turned, with "Keep your flags up. We'll keep our glasses on you, and when we can see you no longer we shall know that you are safely on your way home."

Maybe these pastels from memory's crowded gallery, although but thumbnail sketches as it were, will give a clearer and better idea of the real

Peary than more detailed descriptions or refined analysis. Of his personality none could be near and not be conscious. Grave, calm, and perfectly self-contained, yet as far as possible from chilling reserve or bored indifference, with a sense of real humor, which, among intimates, could take and make a joke with the best—yet always with a fine and inborn sense of the courtesies and conventions, of the rights of others, and the value of time.

Peary rarely in my hearing talked much about himself, his use of the first person singular was sparing to the last degree, and if he discussed the campaign, either past or future, it was always in reference to the immediate business in hand, some matter of detail and mutual coöperation, in which each should bear a hand and know and understand the work which had been cut out for him. Even when the great prize had been won, and the victory of twenty years achieved, his manner, tempered by repeated repulse and disappointment, did not outwardly change, and no man ever heard from him a boasting or vainglorious word.

To define the value and estimate the effect of Peary's work is not the present purpose. Nor is it necessary. The scientific societies and authorities of the world without exception or reservation have done that, and probably no other man living or dead has received more emphatic and unanimous recognition and reward of merit. It is proper, however, here to say that no association, nor appreciation of his effort and endurance gave him more gratification or kindled livelier response than that from the American Museum. President Jesup's support and counsel were strength and inspiration, and the confidence and friendship of the officials and staff were a source of unfailing satisfaction.

"Duty, honor, country," the West Point cadets read on the great oriel of their noble chapel, and, unwritten, these were Peary's living motto. Ambition urged him on, but science and patriotism fed its flame, and on that eventful April day when he reached the Pole, it was the flag of his country, with him in all his Arctic wanderings, to be above him at the grave, that proclaimed the victory. Reviewing the causes and recalling the man, both seem simple and harmonious.

Blood of France and Britain mingled in Peary; the waters and islands of Casco Bay and the hills around trained the athlete, the sailor, and the hunter; the schools and college of his state gave him knowledge of books and men. Florida and Nicaragua gave him the practical and severe discipline in his profession, so that when he took the field, actually entered the arena for his life work, there was no joint in his armor, no detail of mental or physical equipment deficient. To complete the picture, to inspire and illuminate the life, to all this may be added ideal filial, conjugal, and paternal relationships, to which more of success than the world will ever know is due.

Echoes of "taps" and the volleys followed us out of snow-clad Arlington. Of whom could it more worthily be written in the immortal lyric inscribed on the roadside tablet:

"On Fame's eternal camping ground
Their silent tents are spread,
And glory guards with solemn round
The bivouac of the dead."

Courtesy of the New York Times

THE CAISSON WITH A NAVAL ESCORT WOUND ITS WAY THROUGH THE LANES OF ARLINGTON CEMETERY

ADMIRAL ROBERT EDWIN PEARY, 1856–1920
NORTH POLE, 6 APRIL, 1909

Medal by Sigurd Neandross

The scientific societies and authorities of the world without exception or reservation have defined the high and authentic value of Peary's work, and probably no man has ever received more emphatic and unanimous recognition and reward of merit. In witness thereof more than a score of medals have been presented to him by the great geographical and exploring societies of Europe and America

Scientific Research as a Public Function

By T. D. A. COCKERELL

Professor of Zoölogy, University of Colorado

IT is a commonplace observation that most of our material progress is due to science. The English naturalist, Wallace, thought that there had been more discovery and invention during the nineteenth century than during all previous centuries. It is certainly true that the whole structure of civilization has been altered as the result of scientific work, and today the rate of development is greater than ever before. Progress begets progress, and we are perpetually obliged to readjust ourselves to new conditions. Whether we approve or object, we have no option if we wish to maintain our place in the world. We are somewhat in the position of the Red Queen in *Through the Looking-Glass*, who had to run as fast as she could to keep in the same place.

During the early part of the nineteenth century, Malthus attracted much attention by his dismal prophecy of the overcrowding of the world and the prospective lack of the necessities of life. Populations have greatly increased since his time, but science has so greatly augmented man's power to produce wealth, that we have more per capita than in any previous period. Not only this, but we can see ahead to a time when present production will look relatively insignificant. In modern times disease has been partly conquered, and premature death has been largely prevented. Here again it is a reasonable expectation that some of the most serious diseases will disappear within the lifetime of the youngest persons among us.

Along with this progress of science, and partly because of it, democracy has grown apace. The United States has demonstrated to the world that a whole continent can be organized successfully into a coöperative commonwealth. Kings, courts, and nobles have been discovered to be superfluous, and universal public education has proved itself a brilliant success. If we still fight, it is to combat the methods of a bygone age, and within the democratic fold war appears to have been abolished.

The gains of science and democracy have been enormous. Nevertheless, we are discontented and unsettled, deeply disappointed with the results of so much intelligent labor. We even look with a kind of envy at the naked savage, living a simple life in the primitive forest. He at least knows how to behave, and has little to regret. This is not mere meaningless sentiment, it is actually a fact that the average man is less accurately adjusted to his environment than most wild animals. We have created an enormously complex machinery which we do not know how to operate quite successfully.

It has often been said that the remedy for the ills of democracy is more democracy. So also, the remedy for the ills of science is more science. In other words, the scheme of things must be completed, the parts of the machine must be brought to a common level of efficiency. When we look out upon the present world, it appears that material advance has gone far beyond moral progress, and one is apt to wonder whether the former should halt to allow the latter to catch up. Professor Ross has shown how progress itself is a cause of delinquency, how all the crooks disport themselves in the margin of opportunity which fringes the moving front. But the problem after all is very much like that which confronted our Army in the recent war. It was necessary to advance, but the gains had to be consolidated. The whole organization had to move together, according to a definite plan, or the very successes would have turned into defeats. It requires little investigation to determine that the front line of our American civilization is extremely irregular, and that many of the trenches are poorly constructed. We are doing things in a far finer and grander way than the savage, but not doing them so well.

The problem of science is the problem of democracy: it is even at the root of morality. What morality is there, in this world, but to learn where we are, and where we are going, and act accordingly? Good morals must be judged by their results, and not by the intentions of those who practise them. The world resounds with the conflicts between well-meaning persons who might have peace and harmony if they would only stop to use their intellects. Take a concrete instance, that of the recent controversy in the steel industry. It apparently never occurred to the leading operators to ascertain the precise effect of their rulings upon the thousands of persons working for them. Neither did it apparently occur to the strikers to secure expert testimony, and present to the public a statement of the inescapable objective facts. A skilled physiologist could show the effect of a twelve-hour day, under the conditions of the steel industry, in a manner that could not be gainsaid. A sociologist could elucidate other matters, and even a psychologist might have his contribution to make. Well, operators and public, if it is demonstrated beyond contention that the industry is impairing the efficiency and spoiling the lives of thousands of persons, do you wish that to continue? Of course you don't; but as things are, you really don't know much about it, and give yourselves the benefit of the doubt. The truth is, you are not competent members of a democracy, and so the democracy you belong to is a lame affair, and not at all what it ought to be. But you are mostly honest and well-meaning, as were the medieval monks who carried the holy relics around the churchyard in an effort to combat the bubonic plague. They should have killed the rats.

We are apt to think of scientific research as something above the clouds, something which requires a genius for its production. Darwin, Newton, Kelvin, or Pasteur,—can such men be made to order or fitted into a public organization? When we think of the great theories, the great discoveries, they seem like gifts of the gods, bestowed by the caprice of heaven on a public which has done little to deserve them. The actual facts, however, are quite different. All these men did an immense amount of scientific work and utilized the work of many others. It was from the synthesis of patiently acquired data that the discoveries or generalizations emerged. All these men, moreover, required material accessories, and had them. They also required, and had, the coöperation of their fellows. A nation is justly proud of its great scientific men, because they represent the finest flowers of national activity. The same principle holds good in the arts, even in a subject so little constrained as poetry. Lady Gregory, lecturing in this country on the Irish drama, urged us to develop local dramatic talent everywhere. This, she said, partly because it is worth while in itself, and partly because it is only in an environment of interest and opportunity that great drama is likely to arise. Grant that we cannot make poets to order, we can at least prepare the ground in which the seeds of poetry will grow. Precisely the same is true of science.

For the practical purposes of democracy, however, we need the minutiæ of research. We do not expect to run the city or factory by the light of some astounding new principle presently to be discovered. Instead of that, we want to know about the distribution of mosquitoes, the character of the fatigue curve, the condition of the milk, and so forth. We not only want to know these things, but we need up-to-date information all the time: the price of well-being is eternal vigilance. We cannot wait until some gifted individual feels moved to investigate: we must organize a scientific staff. Some people would deny the name research to such activities, just as they deny the title poetry to many kinds of verse. We need not quarrel about the name, but it is actually impossible to draw any distinct line between the different types of work. The most simple details, if gathered systematically and according to a plan, may be made the basis of important generalizations. This is true even of such a thing as the census, in the making of which the research spirit is wholly absent. We need to see ourselves—not indeed as others see us—but as we actually are. We must constantly measure our powers and opportunities, and plan our conduct in the light of what we have learned. This we do not do, and yet it is easy to see that we might vastly improve our condition, and do away with the leading causes of discontent.

At the time of the Walsh Industrial Commission, I tried to interest the then president of the University of Colorado in a plan for the continuous study of the local industries, particularly coal mining. Up to the present time it has not been possible to organize such a bureau as I contemplated, and in fact the University has no research program. While teaching has been fully systematized, so that every grade earned by every student is duly recorded, research is a voluntary or, as it were, parasitic industry. We are by no means peculiar in this. The university is the natural and proper center for research. There are to be found the laboratories and libraries, and there should be the men. The complaint is made that the public will not support the work, it will not even adequately support the teaching. But the public has never had the matter presented to it in any intelligible form. It is necessary to make some exhibit of the goods for sale in order to obtain a purchaser. The people have paid over and over again for they knew not what. It is a sign of intelligence on their part if they want to be shown, but it should be easy to show them.

It must be admitted that our scientific men are not yet wholly awake to their great duties and responsibilities. They are still imperfectly socialized. They justly dread the interference of ignorant or stupid persons in authority, and to avoid this danger would preserve their independence to the uttermost. Science undisciplined and unorganized is at any rate free. Yet the work of the world must be done, and whether it is done wisely or stupidly must depend upon science. We must therefore strenuously object to the minute passed by the Council of the American Association for the Advancement of Science, requesting the sections to exclude papers dealing with current political questions, on which public opinion is divided. Partisan propaganda posing as science would be detestable, but it is precisely upon those questions on which opinion is divided, that the clear light of science should be shed. When we are sufficiently educated, we shall habitually turn to science as to an umpire.

There is one great contribution to the public good which I think should be made without delay. The ablest experts in the country should get together and define the *American stand-*

ard of living. Not the actual standard, determined by statistics, but the optimum standard possible in an enlightened democracy.[1] What does a man need to maintain his health and working efficiency? The inquiry would naturally resolve itself into two parts. One would deal with personal requirements, such as food, clothing, housing, and so forth. The other would have to do with social arrangements,—education, parks, opportunities for recreation, and the like. The standard could not be exact; but if carefully defined and supported by adequate authority, it could be given sufficient publicity to have it discussed in nearly every home in America. It would serve as a measuring stick to measure roughly and compare the conditions in every industry or occupation. It might be revised from time to time; and as fast as the facts could be gathered, special standards should be indicated for special circumstances. While the obvious and immediate purpose of the standard would be to raise those *below* it, there might be some utility in considering cases *above* it, as indicating wasteful and purposeless expenditure. The discussion of the standard would also call attention to the problem of adequate production. Some economists think there would not be enough to go around, but it is inconceivable that with modern methods we could not meet every reasonable requirement.

During the recent war, we feared that it might be difficult or impossible to carry on all the important agricultural operations, and in Colorado we discussed the possibility of dismissing the university students for a few weeks to prepare the ground or get in the crops. No such step proved necessary, and there is no doubt that such instruments as the tractor and the silo (to mention the two most conspicuous to the passer-by) had a great deal to do with the successful conduct of the war. Still more striking are the triumphs of plant breeding, and one who has followed all these matters with any degree of attention cannot fail to be optimistic regarding the possibilities for enormously increased production. Sir Daniel Morris recently made the following statements, as quoted in *Nature*, September 11, 1919, page 37:

"As the result of Biffen's plant-breeding work at Cambridge, new wheats have been produced and grown over extensive areas in the eastern counties [of England] that have yielded crops at the rate of 50 to 60 bushels per acre. In one instance an area of a little over twenty-seven acres has yielded 2072 bushels, or an average of 77 bushels per acre. This is to be compared with the average yield of wheat in this country at about 32 bushels per acre. The new wheats are not only more productive, but are less liable to disease, and the quality of the flour is superior to that of ordinary English wheats. In regard to India it is estimated that the Pusa wheats raised by the Howards will shortly be established over five million acres, and it is anticipated that they will bring in an increase in the value of the agricultural produce of India, in one crop only, of 75 lakhs of rupees of five millions sterling."

[1] A good beginning has been made in a recent bulletin: "Tentative Quantity and Cost Budget Necessary to Maintain a Family of Five in Washington, D. C., at a Level of Health and Decency." *Bulletin of the United States Department of Labor*, 1919.

A Miocene Catastrophe

By DAVID STARR JORDAN

Chancellor Emeritus, Leland Stanford Junior University

A GREAT many years ago, in round numbers let us say about 2,000,000 B.C., in the age called Miocene, the coast line of California was in a formative stage. Great deposits of sand and clay were being rolled up and folded as mountain chains, and their nascent peaks and ridges formed an archipelago of islands with sheltered bays. Here were developed immense masses of diatoms, microscopic plants, each with a fine shell of silica, most of them having the form of a flat disk, adorned with thimble-like depressions and spinules of complicated sorts. The number of these creatures must be beyond conception for, in the locality mentioned below, they are piled up solidly to the average depth of fourteen hundred feet over a territory two and one-half miles long, and more than a mile and a half in breadth.

In this locality the deposits are free from sand, which shows that no fresh water came in; but in other places, over dozens or hundreds of miles, from Kern County to Orange, the diatom masses are interspersed with sand and clay and at times completely buried under them. From above these buried masses exudes the oil called petroleum. It is known that each diatom when alive secretes a minute droplet of this oil. But this is a theory: now to a concrete fact.

In a little bay on the north side of the Sierra Santa Ynez in Santa Barbara County, just above the present town of Lompoc were measureless masses of diatoms, covering the bottom at first to a depth of about 950 feet. For some reason this bay was chosen as the spawning ground for a herring of those days, known now by the name of *Xyne grex*.[1] This fish was much like a modern herring, except that its surface bones were covered with enamel, a ganoid fashion of those Miocene years long since gone out of date, so far as herrings are concerned. This species had, moreover, a row of sharp enameled spines along the edge of its belly. Something like this still persists in many forms of herring—as the menhaden and other so-called "saw-bellies," but these are plain nowadays, the enamel all off.

Into the bay at one time came millions on millions of these herring—all of a size—six to eight inches long, doubtless for spawning purposes. But they covered the whole bottom of the bay—four square miles—and very evenly at that. That is the marvel, and now comes the catastrophe. For none ever got away; they all lay down and died and were promptly buried under the diatoms—350 feet of diatoms at least. But the erosion of the years has cut into these masses in different places, laying bare the strata in which the *Xyne* lie. And whenever one strikes that horizon, there are the fish, all in the same stratum, none below, nor for many feet above. The skeletons are all well preserved, not much crowded, and the organic part of the skeleton is carbonized so that the bones are all dark brown or black.

The accompanying photograph (on page 20) shows a slab of diatom rock, twenty inches by sixteen, with thirteen of these fishes upon it, besides parts of others. This seems to be a fair average for the whole stratum, and indicates that the total number in the bay on the day of the holocaust was about 1,337,195,600, a mighty school of fish!

About six feet above this deposit of *Xyne*, throughout the basin, there lies a thin layer of transparent volcanic

[1] *Fossil Fishes of Southern California*. By David Starr Jordan and James Zaccheus Gilbert, 1919, pp. 25–26.

GREAT DEPTHS OF THE DIATOM DEPOSITS AT LOMPOC, CALIFORNIA

This picture of a quarry among the diatom hills of California indicates to the imagination better than figures the countless myriads of the microscopic plants which were deposited in this place. The number has been calculated as represented by the numeral 1 with thirty ciphers attached. But for all we know, forty ciphers may be equally correct. These diatoms, chiefly species of the genus *Coscinodiscus*, were developed in the locality where they are now found when this was a sheltered bay among an archipelago of islands, formed by the nascent peaks of the California coast. Among other peculiarities of the deposits is their exudation of petroleum, a phenomenon as yet not wholly explained, although probably connected with the fact that each diatom when alive contains a minute droplet of oil

A RECORD IN STONE OF AN EXTINCT HERRING

Earthquake or other catastrophe destroyed more than a billion herring—they themselves wrote the story in stone for future ages to read. In what was once a bay, when the Sierra Santa Ynez, of Santa Barbara County, California, were below sea level, are to be found the remains, representing an extinct species, *Xyne grex*. These myriads of fish had entered the bay and spread over the four square miles of bottom, doubtless for the purpose of spawning, when some catastrophe overtook them and they all, with one accord, lay down and died. Subsequently their remains were buried under masses of diatoms. The organic parts of the skeletons are carbonized so that the bones are black, as is generally the case with animals decomposed under water where more hydrogen and oxygen than carbon are given off with a residue of the last, the final result being the noncrystalline mineral, collophane (carbono-phosphate of lime)

Masses of diatoms have been heaped up in this small pocket of the Sierra Santa Ynez, in some places to an average depth of fourteen hundred feet. Diatoms are microscopic plants (a few common species shown on page 84), each encased in silica. Countless millions of these microscopically small cases of silica, mixed with clay and sand, are found in deposits in many localities including the greatest depths of the sea and the rocks of high mountain ranges. The California deposits are, perhaps, the most notable in the world in extent and thickness, and above these diatom masses are patches of coarse conglomerate containing many bones of whales and sharks' teeth

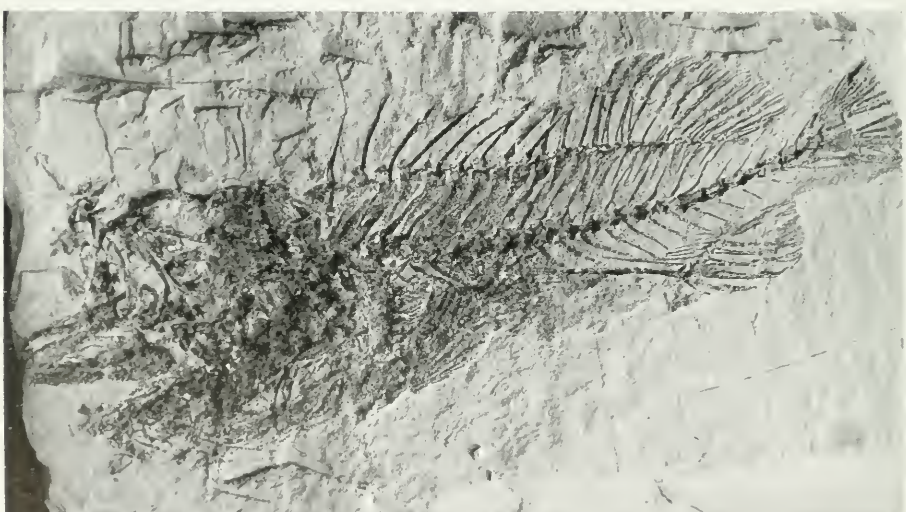
Diatomaceous earth is employed for many purposes, depending somewhat on its texture and the amount of clay and sand intermixed with the siliceous cases. The deposits at Lampoc, California, are quarried for a material used as nonconducting packing for steam pipes and for filtering liquids. It was in a section of this deposit, about 350 feet below the present surface, that the herring shown on the opposite page were entrapped in Miocene times. In the layers above occur numerous fossils, but there are no such masses of them as were accumulated by this single catastrophe glass. Again, long after this was deposited, the whole area was thrown together into low folds. The *Xyne* deposits now stand at an angle of about thirty degrees in the place where this slab was obtained.

Above the *Xyne* lie further deposits of pure diatoms, to the depth of 350 feet. In the upper stretches are many fossil fishes, of about twenty kinds, so far as observed, largely broken into fragments. Four kinds of Spanish mackerel, two kinds of porgy, a big sea-bass, three species of flounder, two rock-cod, two kinds of croaker, and others are present. Among these are two species of herring, one of them being *Xyne*. This, however, nowhere except in the one great layer, exists in mass or in large numbers. All these fishes of the upper regions are mainly molds, imprints of a fish skeleton, replaced by diatoms. None of the herring skeletons is black or carbonized, like those taken in the great layer below. In the upper strata occur also a species of *Mergus* (fish duck), a heron, a porpoise, and a whale. Above the whole diatom mass lies in places a coarse angular conglomerate, with many inchoate bones, mostly of whales, teeth of a man-eater shark, and here and there masses of limestone filled with *Pecten* shells and other Miocene mollusks.

These hills are now occupied by quarries, the diatom masses being sold under the patented trade name of "Celite." The material is used as non-conducting packing for hot pipes ("Sil-o-Cel") and for filtering liquids ("Filter-cel"). The siliceous crusts of the diatoms are insoluble in ordinary liquids, and by pouring them into a fluid and then filtering, everything in suspension is caught by the diatoms.

Two problems remain, both probably insoluble. Why was this bay crowded with a billion individuals of *Xyne* to the exclusion of all other fish? Why did they all die instantly, quietly, with no sign of agony, and how were they hermetically sealed before going to pieces in decay?

Heat, poison gas, earthquake disturbance—you may answer. But no one knows, and anyone's guess is as good as yours or mine.



This big rock-cod (*Rixator porteousi*, shown less than one third size) probably perished in the same fashion as the herring but at a later date. Its head is crushed as is the case with fish which die in the sea, for the skeletons of the bodies are picked clean by small organisms, but the brain is left within the skull and causes these bones to decay

A Chapter of History and Natural History in Old New York

By GEORGE BIRD GRINNELL

THE wild life of New York City is for the most part transient; we see only birds of passage. During the migrations, native birds sometimes drop down into parks, back yards, or other open spaces, and are recognized by the passers-by as different from the English sparrow. People who know birds occasionally recognize thrushes, blackbirds, warblers, and even scarlet tanagers in the smaller parks; and sometimes other birds appear, as when a few years ago I saw a woodcock in Trinity Churchyard at Rector Street, and still longer ago, one in Union Square, which, when started, flew straight east through 16th Street to alight no doubt in Stuyvesant Square.

The larger parks, like Central Park and Bronx and Prospect parks, permit birds to live under more or less natural conditions, and shelter, besides the birds, a few mammals—two or three species of squirrels, cottontail rabbits, and other lesser creatures. A few years ago a brood of wild black ducks was reared each year in Central Park, and in the New York Zoölogical Park various wild ducks are bred.

The presence of many people whose minds are occupied with other things than wild life tends to make safe not a few wild birds that spend the summers and rear their young in safety close to the city throngs. In the tide-water flats and marshes of Long Island City and of the outskirts of Jersey City, there are still no doubt—as there were a few years since—many places where blackbirds, coots, rails, shore birds, and other species not often seen, breed each year in safety. Duck hawks still rear their young on ledges of the Palisades and it may well enough be that near New York there are other breeding places of large birds.

My boyhood was spent in the country on the banks of the Hudson in Audubon Park. This had been the home of John James Audubon, and was then six or seven miles from the built-up portion of New York City. The only way of reaching it was by train from the Hudson River Railroad Station at Chambers Street, or by a stage which twice a day plied between Saul's Tavern, at 162d Street and Bloomingdale Road, and the corner of 36th Street and Broadway. There were few buildings north of 35th Street, and market gardens, which supplied vegetables to the city, began on the west side of the town near 40th Street, and extended far into the country. Ground for Central Park had just been set aside, but nothing had been done to transform it from a great piece of wild waste land.

The conditions about Audubon Park were thus those of the country, and no doubt it was for this reason—because of its distance from the city and its freedom from people—that it had been chosen as a residence by the naturalist. In the woods and fields were found many of the birds that occur anywhere in the country of the eastern seacoast. During the migrations, ducks and geese were seen flying up and down the river, or over Manhattan Island; and a list of the birds would not, I suspect, have differed greatly from a bird list made anywhere else along the coast from Greenwich to Hackensack.

A notable feature of the wild life in this once remote region was the music of the birds, and chiefly the song of the wood thrush, great numbers of which nested among the hemlocks and white oaks and the undergrowth that stood there. Morning and evening each singing thrush, perched on the stout branch of giant white oak or hemlock—he seems to prefer that to a twig—poured forth his liquid notes, which, clear as a bell, rang out on the quiet air. Some people used to say that the notes of the thrushes of Audubon Park seemed to possess a clearer, more resonant quality than those of others of their kind, and rather sentimentally connected the sweetness of their song with the associations of the place.

The mammals were not many. There were three species of squirrels, of which the red squirrels were most abundant and the grays least so; while, owing to their nocturnal habits, the flying squirrels were seen only occasionally, although actually they were numerous. Trinity Cemetery was then enclosed by a high board fence, painted gray-blue. The horizontal boards were fastened to rough posts which were hidden by two vertical boards nailed on each side of the post and meeting outside it at an angle. In the high triangular chambers thus formed, there was often much space between the post and the boards, and here the flying squirrels used to make their nests. Some one of the boys at last discovered this habit, and after that most of the neighborhood lads maintained for a time a cage of captive flying squirrels, for the little animals were very abundant.

There were many muskrats on the rather extensive tidewater flats and coves of the Harlem River, and in winter, with Jack Audubon, I often went over to these flats to assist at the shooting of the muskrats.

At that time an arm of the Harlem River ran south through what are now the Polo Grounds, about to 145th Street, but east of this arm was a tongue of land which ran up toward McComb's Dam bridge. This is the present Eighth Avenue. Crossing the tidewater flat—in a general way about where the viaduct at 155th Street now runs, but really somewhat south of it—was a little footbridge, two planks wide, the planks resting on slender poles driven into the mud of the bottom. A footpath ran down the very steep hill near where 155th Street now is, and the little footbridge led from this path across to the solid land to the eastward. In this water there were many muskrats, and after ice had formed over it, they resorted to holes in the ice where we watched for them. They were not often killed, but occasionally one was recovered, and very often we believed we had killed one that had gotten away. Jack Audubon was often permitted by his father to carry his grandfather's gun, and he used it on his shooting excursions.

None of the modern streets or avenues was then open, and there were practically no dwellings along the Harlem River above Harlem Village. The steep, rocky bluff which overlooked the Harlem River, between about 150th Street and the High Bridge, was covered with a growth of tall, hardwood trees, chiefly oaks and chestnuts, and in these trees many crows bred as did also woodpeckers, blue jays, and smaller birds. Little screech owls often occupied the holes in trees abandoned by the golden-winged woodpeckers, and on more than one occasion a small boy thrusting his hand into the hole to feel for woodpecker eggs, found his fingers deeply pricked by the sharp talons of the little owls.

Between 158th Street, which was the northern boundary of Audubon Park, and Fort Washington, a mile to the north of that, was a stretch of woods interrupted in two places only by lanes leading from the main road along the ridge down to private dwellings near the river. In these woods were many rabbits, and I have always believed that on one occasion I started there a ruffed grouse.

At that time, and for many years afterward, there existed near the High Bridge—that is to say, just south of 175th Street, west of Tenth Avenue, and east of the so-called Bloomingdale Road, now perhaps Broadway-Eleventh Avenue—a considerable swamp which possessed a mysterious fascination for the boys of that time and place. Green herons bred there in considerable numbers; that is, we could always find a dozen nests. The birds were tame, for after the novelty of discovery had worn off, the boys seldom disturbed them and they soon became accustomed to the boys. Woodcock bred on the borders of this swamp, and were occasionally seen there and shot at in autumn. South of the swamp, which we called "the green heron woods," was a rather wide extent of pasture land, interruptd by occasional old stone walls and copses of undergrowth, to the point where Tenth Avenue and the present St. Nicholas Avenue cross—about 162d Street. After I had learned how to prepare bird skins, this large triangle was one of my favorite collecting grounds. It was varied in character and was frequented by a multitude of migrating small birds. For many years all this tract has been covered by tall apartment houses.

In this large triangle, which must have been three-quarters of a mile long, I recall but a single building—the old colonial stone structure known as the Cross Keys Tavern. There was a tradition that once Washington had slept there, and when I was a small boy, and perhaps much later, there still swung from a beam projecting out toward the road—west—a large weather-beaten sign on which were painted the two long keys crossing each other which gave the house its name. I cannot recall that it was ever used as a tavern.

During much of the winter the Hudson River was full of ice, on which eagles and crows were constantly seen perched or walking about, feeding no doubt on the refuse and the bodies of animals thrown into the stream farther north. There was a crow roost on a cedar-crowned knoll north—or east—of the Harlem River, but west of the New York, New Haven and Hartford Railroad and south of High Bridge. At daylight each morning the crows flew westward to the Hudson River, and on days when it was foggy or when it was snowing they often flew very low, even among the tree tops. The first crow I ever killed was shot just at dawn from one of the upper windows of the house as it flew over.

Sometimes the eagles from the river alighted in the large trees not far from the house, and at least on one occasion one of the birds dropped a fish which was picked up by the children.

After the small boys of the time were old enough to carry guns, they devoted much of their time at certain seasons of the year to excursions after what they considered game. This game consisted chiefly of small birds, robins, woodpeckers, meadow larks, wild pigeons, and, at rare intervals, a rabbit, or even a duck. In the woods north toward Fort Washington were many dogwood trees, and in autumn when the berries were ripe birds came here in great numbers to feed on the fruit. We used to sit near such trees and shoot the birds, which in due course were brought home and cooked. As we grew older we extended our wanderings farther afield, and worked our way north to Tubby Hook and to Dyckman's Meadows on the Harlem River where small sandpipers and small herons were often to be had, and at rare intervals a duck was found. Wood ducks and black ducks were the largest game the boys ever secured.

A longer excursion was up to Van Cortlandt Lake—the present Van Cortlandt Park, which we then called

"Bronson's." From the lake a stream flowed out toward the Harlem River through a wide marshy meadow, largely overgrown with flags and high grass. This, in autumn, was a resort for blackbirds, and here Wilson's snipe were sometimes started, but the small boys never killed them, nor any of the quail which were often seen, but which flew too fast for us.

One spring day I watched for a long time an osprey repairing its nest in a tall tree on a hill northeast of Van Cortlandt Lake. The nest seemed an old one, for it was very large, and the bird, as it swung over the ground in flight, was picking up bits of sod or of dry grass to use on the nest.

I had been to Van Cortlandt Lake long before these days, for when I was a very small boy two or three of the Audubon Park families had driven up to the lake on an all-day picnic. On this occasion my father, who was a great angler, had followed up a brook running into Van Cortlandt Lake and captured there an enormous trout, perhaps the only large fish in the brook. I should not dare to guess how long or how heavy this trout was, but I remember that it was regarded with astonishment and reverence by the other men of the party who had been less fortunate than its captor.

One autumn, soon after my first gun had been given to me, a woodcock made its appearance in our garden—near what would now be the corner of 157th Street and Broadway—and, until cold weather came, gave me a great deal of shooting. After I had learned that the bird was there I went out into the garden each morning before breakfast, found the bird, and shot at it. Later in the day I sometimes found it again and had another shot. I never hit the bird, but had much excitement in its pursuit.

Until as late as 1890 or 1895, quail and woodcock occasionally made their appearance in Audubon Park. The presence of the woodcock was always explainable, but I never was quite clear in my mind as to where quail came from.

Up to the time when that portion of Audubon Park east of Riverside Drive was swallowed up by the city—1909—two or three broods of little screech owls were reared each year in the great trees that grew in the place. From the piazza and the front windows of the house, in summer, the little owls might be seen almost any day dozing in the holes in the trees or on the branches. Now and then the children would find on the lawn a downy young owl that had fallen from a nest, and the work of returning the fledgling to a place of safety was always an exciting task for the children and for the parent birds.

The long-eared owl was occasionally seen on and near the place, and it was reported that the barred owl bred in the woods south of Fort Washington, although I knew nothing more than the report. In winter the snowy owl occasionally appeared, and the saw-whet owl was another winter species.

Up to 1909 golden-winged woodpeckers bred in some of the large trees on the place and it is quite possible that today some of these birds may breed in the Trinity Cemetery near by.

Such winter birds as the red and the white-winged crossbills and the snow bunting were occasionally seen, the crossbills as late as 1895-96, when a flock was observed one Sunday hard at work on the cones of a hemlock tree close to the house. A bird seen in winter, but not a winter bird, was a cardinal grosbeak, which made its appearance in February, 1867, on a small dogwood tree close to the house.

Wild—passenger—pigeons were seen each autumn at this point, and the boys used to have not a little excitement in shooting at them from the top of the house as they flew over north and south. It was discouraging work, for they really flew too fast to be hit, yet occasionally we got one. Many ornithologists will remember an article which appeared about thirty years ago in *The Auk,* from the pen of the veteran ornithologist, George N. Lawrence, which described conditions as he had found them at Manhattanville, not many years before the time of which I am writing.

New York has been spreading out and exterminating wild life for nearly three centuries. Thirty or forty years before 1860 the Lispenard Meadows afforded good snipe shooting, and in what are now Tompkins Square, Central Park, Broadway from about 46th Street to the North River, and Fifth Avenue at 32d Street, there was good woodcock and rabbit shooting. The growth from small population to great has taken place too often in American cities to cause us much surprise. Our larger wild life has for the most part disappeared, and population has increased so rapidly and territory has been so generally occupied that such changes will be less startling in the future than they are today.

As transportation facilities increased between the southern and the northern portions of Manhattan Island, population spread northward, and with a growing population, conditions became less favorable to the existence of wild life in upper New York. Broadway was opened in this region about 1874, I think, and somewhat later the elevated railway brought a host of people northward. Nevertheless, it was not until after 1900 that the wild birds became notably fewer. But, after the completion of the subway, the march northward of the tall buildings began, and the transformation was rapid.

House on the Hudson about 1842 where lived John James Audubon, between what are now 155th and 158th Streets and Amsterdam Avenue (From title page of *Audubon, the Naturalist of the New World.* By Mrs. Horace St. John, 1856). In the generation after Audubon the region was known as "Audubon Park." The conditions all about were those of the country, with the city six or seven miles to the southward. The music of wild birds was especially notable; many people influenced by the associations of the place used to say that the songs of the wood thrushes of Audubon Park possessed a sweeter, more resonant quality than anywhere else. Broadway was opened through about 1874; later, the elevated railway brought the population northward. As late as 1890, however, quail and woodcock appeared; in fact, not until about 1900 did the number of wild birds greatly decrease, but finally, about 1909, the city having completed the subway and covered the land with tall buildings, Audubon Park and its wild life were swallowed up

FLANKED BY MOSS-GARLANDED CYPRESSES

The Cowhouse Run is one of the fairest spots in the entire Okefinokee. It passes between colonnades of cypress trees festooned with swaying gray tillandsia. The surface of the run is almost shut from view by water lilies and "never-wets" (*Orontium*) which scrape against the boat as we pole it through them.

To convey by pictures or words any conception of the unusual beauty of this southern swamp is impossible, and to wander through it is an adventure quite apart from all the ordinary experiences of life.

Considerable scientific study has been done in Okefinokee during the last ten years, especially by the United States Biological Survey and the scientific departments of Cornell University. There is no more suitable area in the eastern United States for an outdoor biological station. Here a study of life histories and ecological relations can be carried on in undisturbed primeval conditions.

Okefinokee Swamp as a Reservation

By FRANCIS HARPER

Assistant Biologist, United States Biological Survey

THE famous Okefinokee, "the greatest natural wonder" of Georgia, covers nearly seven hundred square miles in the southeastern part of the state, between the city of Waycross and the Florida line. Among the fresh-water swamps east of the Mississippi, it is exceeded in size only by the Everglades; and in the richness of its historical and literary associations, in the marvelous beauty and charm of its diversified scenery, and in its extraordinary interest as a faunal and floral area, Okefinokee Swamp is unique. It has no counterpart anywhere in the world.

There are several respects in which the swamp would make a particularly useful and valuable reservation under federal or other auspices. It is a refuge for some exceptionally rare forms of animal life. It is an important wintering ground for large numbers of migratory waterfowl. It still contains, in spite of extensive lumbering operations, about five hundred square miles of diversified territory in an absolutely primeval state, offering to naturalists unsurpassed opportunities for faunal and ecological studies. Moreover, it has a distinct æsthetic value; the extraordinary beauty of its scenery makes a strong appeal to all lovers of nature who have been privileged to visit the region. Professor James G. Needham has characterized a scene on Chase Prairie as "one of the most remarkable landscapes in the world."[1] If the destruction which now so direly threatens the swamp is permitted to be carried out, one of the most interesting natural features of our country will be lost forever.

While the Okefinokee has enjoyed historical and literary renown for more than a century, it is only within a comparatively few years that its biological features have been systematically investigated by men of scientific training, and that the published results of their work have begun to appear.[2]

The Animal Life of Okefinokee

In the eastern United States there is certainly no area of equal extent which affords such exceptional opportunities for the study of animal life in a primeval environment as does Okefinokee Swamp. With the rapid destruction of natural conditions over the entire country, it is of the utmost importance, from the standpoint of science, that at least a few areas here and there should be preserved in their original state. The following notes touch upon just a few of the rarer or more interesting forms among Okefinokee's marvelous wealth of animal life.

There are probably between one and two hundred black bears in the swamp and its immediate environs; the Florida deer is a rather common and well-distributed species on the islands and in other parts of the swamp; the Florida otter is a fairly common denizen of this wilderness; several panthers have been recorded about the borders within the past few years; a Florida wolf was killed near the edge of the swamp about 1910; and some animal believed to be a wolf was heard in the swamp several times in 1916. This species is virtually extinct, and there are only one or two specimens in the museums of the country. That curious little animal, the

[1] James G. Needham and J. T. Lloyd, *The Life of Inland Waters*, Ithaca, 1916, p. 93. For a general description, history, and map of the swamp, cf. Wright and Harper, *The Auk*, XXX, October, 1913, pp. 477–505.

[2] See the appended bibliography.

The illustrations are from photographs by the Author.

Florida water rat or round-tailed muskrat (*Neofiber alleni*), has just recently been discovered in the swamp. It is very abundant here in its only known habitat in Georgia.

The ivorybill, our greatest and most magnificent woodpecker, now on the very verge of extinction, has maintained in the Okefinokee one of its last strongholds. The Minne Lake Islands, its principal haunt, were reached by lumbering operations about two years ago, and the few remaining birds may have been driven to some other part of the swamp. The great pileated woodpecker, scarcely less splendid than the ivorybill, is astonishingly abundant, its numbers here perhaps surpassing those of any other part of the country. The American egret, once nearly exterminated for its plumes, has been found breeding in the environs of the swamp. It also has here a safe winter refuge. Late one January afternoon I beheld about eighty-five of these birds winging their way, singly and in bands, over Floyd's Island Prairie toward their roost. The Okefinokee is the only place in Georgia where one may find the sand-hill crane and the limpkin. The former is a resident and quite common species, but only one or two of the curious and fast-disappearing limpkins have been observed in the swamp, which doubtless represents the northern limit of their breeding range. The wood duck is a resident species of which there are probably hundreds of individuals in the swamp. In the entire country there is perhaps no other equally favorable habitat for this rare and beautiful little duck.

As a wintering ground for migratory waterfowl, the Okefinokee is of very considerable importance. Eleven species of interest to game conservationists were found wintering in 1916–17, in numbers loosely estimated as follows: hooded merganser, several hundred; mallard, several thousand; black duck, 1000; green-winged teal, 25; pintail, 50; wood duck, 500; ring-necked duck, several hundred; sand-hill crane, 100; woodcock, 100; Wilson's snipe, 500; killdeer, 100.

The conditions here compared very favorably with those in eastern and central Florida in the winter of 1916–17. Mallards, black ducks, and wood ducks then seemed relatively much more numerous in the Okefinokee than in those parts of Florida. Altogether about eighty-five species of birds have been recorded from the swamp in summer, and about ninety in winter. At the latter season it attracts great numbers of berry- and fruit-eating birds.

At present a considerable amount of hunting is carried on, chiefly by residents in and about the swamp. Deer, bears, and wildcats are hunted with hounds at virtually all seasons of the year. Not only the ordinary game birds, but also such species as the wood ibis, Ward's heron, sand-hill crane, and occasionally even a cormorant or a water turkey, are killed and eaten. The wood duck, although protected by both state and federal laws, is killed in considerable numbers; some have been sold in recent years at the rate of three for a dollar. Wild turkeys are now much scarcer than formerly, but their numbers might be restored by proper protection. Bobwhites are still common.

Trapping is extensively practiced. Great numbers of raccoons and several dozens of otters are taken every winter. Smaller numbers of wildcats, opossums, and skunks are trapped.

The Mississippi alligator, now rapidly disappearing from the haunts of man, has found the Okefinokee a goodly place in which to survive. This reptile was formerly killed in large numbers, but during recent years the hides have brought so little in the market that the hunting has practically stopped. For the student of herpetology the region holds a vast and fascinating store of riches.

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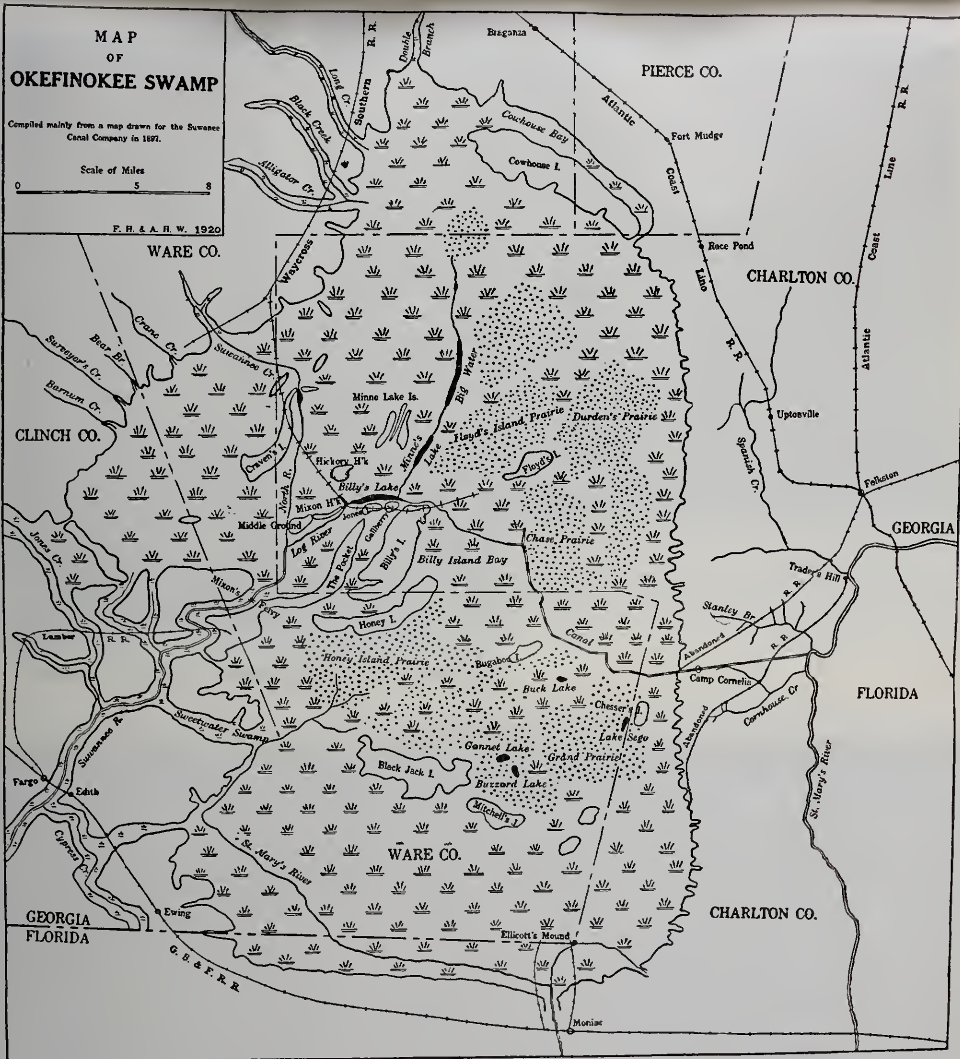

A REGION OF EXTRAORDINARY SCIENTIFIC VALUE

Okefinokee Swamp in southeastern Georgia is one of the greatest natural wonders of North America. It has been known to white men since the eighteenth century, but intimate knowledge of the interior is relatively recent, and scientific study of the region has been undertaken only in the last few years. In 1889, when timber was relatively plentiful throughout the country, the swamp was sold by the state to a lumbering syndicate for 26½ cents an acre. This syndicate dug the canal and laid the now abandoned railway to Camp Cornelia. During the last ten years about one third of the swamp, including the important islands except Floyd's, Black Jack, and Mitchell's, has been cut over or turpentined. These three islands constitute one of the last stands in Georgia of virgin long-leafed pine (*Pinus palustris*).

The Okefinokee Society has been organized to preserve this unique region for "public, educational, scientific, and recreational uses" and proposes to purchase a representative portion of the swamp, if sufficient funds can be obtained, and to present it to the United States Government for administration as a wild life refuge

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The Okefinokee is a refuge for such rare and splendid birds as the ivory-billed and pileated woodpeckers, the wood ibis, the sand-hill crane, and the American egret. Seven species of ducks are found wintering here: hooded merganser, mallard, black duck, green-winged teal, pintail, wood duck, and ring-necked duck. In the somber depths of the cypress "bays", about the first of June, we may find the nest of the Acadian flycatcher, which delights in the solitude of the moss-draped trees above the clear, brown water. The photograph presents a scene just north of Billy's Lake

The photograph below shows the abundance of huckleberries on Billy's Island—an important element in the food supply of both birds and mammals

VIEW OF CHASE PRAIRIE FROM A TREE TOP

The vast open marsh of Chase Prairie, interspersed with pine heads—"one of the most remarkable landscapes in the world"—calls through its sheer wildness to the naturalist and hunter alike for protection and preservation. The call must be answered quickly, however, or the swamp will be stripped of its rich vegetation and drained for dry farm land of doubtful value

SO MAY HAVE LOOKED THE HAUNTS OF THE DINOSAURS

Above the surface of the "prairie" rise purple bladderwort flowers, and white water lilies bloom in myriads. Over beds of quaking sphagnum wind trails of otter and alligator. The rare wood duck hides her young among the yellow pond lilies, and the water turkey soars in wide circles or plunges headlong into the tepid water

The swamp waters abound in fish life, including pickerel, large-mouthed black bass and other smaller bass, short-nosed gars, chub suckers, mudfish (*Amia*), various species of catfish, and numerous killifishes. Among the recent discoveries is a particularly dainty little fish, *Lucania ommata,* which was previously known only from a few specimens taken in Florida; it enjoys the distinction of being one of the very tiniest of existing vertebrates.

The Plant Life of Okefinokee

The wonderfully rich and diverse plant life of the Okefinokee constitutes one of its greatest charms and beauties. And herein one may perceive a veritable illustration of the "curse of beauty"; for it is the magnificent timber of the swamp that furnishes its commercial value and has invited destructive exploitation. There are two major types of forest growth—the pine barrens on the islands, and the cypress "bays" occupying inundated portions of the swamp.

The so-called pine barrens are open forests of long-leaf and slash pines, between whose straight and lofty trunks one may look for a distance of a quarter of a mile in almost any direction. The low undergrowth consists principally of saw palmetto, together with a profusion of huckleberries and blueberries, which form an important element in the food of many birds and mammals. One may find on some of the Okefinokee islands, where the "turpentiner" and the logger have not yet penetrated, the southern pine forest in its finest glory.

In the "bays", which cover a large portion of the swamp, the dominant growth is the pond cypress. Probably nowhere else in the world does it attain a heavier growth or finer proportions. Other trees in this habitat are

The shallow waters of Okefinokee Swamp afford opportunity for this singular and primitive method of night fishing, or "striking," with a homemade machete by the light of blazing pine torches. The fisherman moves stealthily with upraised weapon ready to strike any fish—pickerel, gar, bass, or catfish—which may be revealed by the flaring light the black gum, red bay, white bay, sweet bay, and red maple. Every tree is draped with luxuriant festoons of hanging moss. Among the thick undergrowth in the somber, impressive depths of the "bays," there is a handsome little evergreen shrub, *Pieris phillyreifolia,* which usually starts at the base of a cypress tree and works its way upward between the inner and outer layers of the bark, sometimes reaching a height of forty feet, and sending out branches with leaves and flowers every few feet. This manner of climbing is quite without a known parallel in the whole vegetable kingdom.

The so-called "prairies" of the Okefinokee are one of its most remarkable features. They are essentially marshes, with more or less open water, but filled for the most part with a luxuriant growth of aquatic plants—water lilies, maiden cane, pitcher plants, arrowhead, arrow arum, saw grass, fern, paint root, sphagnum, and many others. They are the favored resort of waterfowl and other especially interesting forms of animal life. Here and there on the prairies stand picturesque clumps or "heads" of cypress and pine.

There are a number of other distinct types of vegetation in the swamp, including hammocks, "sand scrub," sphagnous bogs, and cypress ponds, each with a charm of its own. To behold the marvelous array of natural scenery in the Okefinokee wilderness is something apart from all ordinary experiences. It is all but impossible to convey in words an adequate idea of its exquisite, primeval beauty, or of the emotions it inspires. Practically every piece of literature on the swamp, from William Bartram's account of this "most blissful spot of the earth" to Will Henry Thompson's fine appreciation,[1] reveals something of the singular fascination that the place holds for those who have been so fortunate as to gain intimate acquaintance with it.

[1] See appended bibliography.

The Swamp as a Field for Biological Investigations

During the last ten years the swamp has been utilized as a field for biological reconnaissance work by several of the scientific departments of Cornell University, and it has been further investigated by the United States Biological Survey. Reports on the birds, reptiles, and some of the insects have already been published, and reports on the mammals, amphibians, fishes, and plants are in course of preparation. These reports are largely of a preliminary nature, and should form the basis for a vast amount of further and more detailed biological work extending over many years. It is safe to say that there is no area of equal interest, importance, and suitability in the eastern states for the carrying on of such investigations. The Okefinokee would be an ideal location for a field biological station for the universities, museums, and other scientific institutions of the country. And its whole tremendous value for this purpose—the study of life histories and ecological relations—depends on the preservation of natural conditions.

The late war has demonstrated for all time the necessity for scientific research. Since the opportunities that the Okefinokee presents for the investigation of the laws of nature are alike unequaled and unlimited, is it not a national duty to preserve it?

In connection with its potentialities as a great outdoor biological laboratory, as a game preserve, and as a national park, it is perhaps worth while to remark that the swamp is an exceptionally healthful region.

Commercial Operations in Okefinokee

For ten years past the very existence of the Okefinokee, in any condition worth preserving, has been threatened

The shallow boat is more easily poled than paddled through the rank vegetation of the "prairie." Okefinokee is an ideal haunt for the alligator, which is holding its own here, although rapidly becoming extinct elsewhere in the United States. The photograph was taken on Cowhouse Prairie, a place of solitude and grandeur

A camp among magnolias and live oaks in Floyd's Island Hammock.—The zoölogist in Okefinokee has opportunity to study many mammals in their original environment. Besides deer, black bears, and wildcats, with an occasional panther, and even the virtually extinct Florida wolf, there are in abundance raccoons, opossums, otters, round tailed muskrats, and skunks

The Big Water stretches between shoreless margins flanked by walls of cypress. Here one may paddle with ease for miles along the aisle of clear and quiet water, discarding the forked stick with which the boat is poled through run and prairie

An otter hunter and his trained assistant.—The hound on scenting an otter jumps overboard and pursues and attacks the quarry in its own element. He gets in this way more pelts for the hunter than could be obtained with traps. Considerable hunting of deer, bears, and wildcats with hounds goes on in and about the swamp, although such game becomes scarcer year by year. With proper protection, the Okefinokee would prove a hunter's paradise by rapidly extending commercial operations, until matters have now reached an acute stage. One lumber company, with a great mill near Waycross, has already removed the heavy cypress timber in the northwestern quarter of the swamp, between Suwannee Creek and Billy's Island. The company's railroad, with many branches, now extends to the very heart of the swamp between Billy's and Floyd's islands. Another company has turpentined the magnificent pines on Billy's Island and the Pocket. Thus the area already devastated probably comprises more than one hundred square miles; and there is a constant menace of industrial encroachment from all sides of the swamp.

Fortunately, the entire area in which the removal of the timber either has been accomplished or is being planned, comprises only about one third of the swamp. This lies mainly in the northwestern part, extending south to Honey Island and east to Minne's Lake; and also through the "bay" northeast of Billy's Island to Floyd's Island. In most other parts of the swamp the timber is too small or too scattered to be worth cutting by the present methods. It is most unfortunate, however, that so many of the islands have already been devastated, and that nearly all the rest are marked for destruction.

As this is being written, word comes that operations are on the point of being extended to Honey Island, for the sake of its pine resin and timber; and there appears to be no available means of saving this wonderful bit of the Okefinokee. In the course of two or three years the same fate awaits Black Jack and Mitchell's islands. The pine forests covering these islands, about three thousand acres in extent, constitute practically the only merchantable timber in the entire southern portion of the swamp. Furthermore, in the recently expressed opinion of a prominent lumberman, they are among the last remaining areas of "unboxed" long-leaf pines in the whole state of Georgia. At the prevailing price of lumber it will require no small sum to preserve these islands as rather solitary types of the primeval long-leaf pine forest. Floyd's Island, in the eastern part of the swamp, is the most diversified, and in some respects the most interesting, of the islands. The owners have kept it as a sort of game preserve, and it is evidently in no immediate danger of exploitation.

Even if all the merchantable timber were cut, the large portions of the swamp remaining untouched would still form a valuable wild life refuge as well as a noteworthy and useful field for scientific investigations. There is, however, another menace, which, unless warded off in time, bids fair eventually to destroy the last vestige of interest or value which the Okefinokee holds for nature lovers. This, in brief, is drainage. Plans are already being considered for a definite system of drainage operations, to be started after the timber has been taken out, for the purpose of converting the swamp into land suitable for agricultural purposes. On the other hand, the great cost of the undertaking, as well as the uncertain value of the land after being drained, is a factor which lends encouragement to those who make bold to consider the Okefinokee prairies a greater national asset in their present state than in any other.

The Okefinokee Society

The Okefinokee Society was organized in 1918, its object being "to give authentic publicity regarding the Okefinokee Swamp; to secure its reservation and preservation for public, educational, scientific, and recreational uses." One of the most encouraging features of this movement is the fact that it originated through local sentiment in Waycross, Georgia. The citizens here recognize the scientific and

THE FASCINATION OF THE BOGS OF OKEFINOKEE

There is no line where one may say the land ends and the water begins. In the "strand" between Billy's and Honey islands the hunter totters over trembling beds of floating sphagnum or sinks waist-deep into the oozy muck, while his bearhounds half swim, half wade, through the bog. Okefinokee—"Trembling Earth"—the Indians realistically named the swamp historical interest of the swamp, its scenic wealth, its recreational advantages, and other phases of its many-sided attractiveness, and may be depended upon to help safeguard its welfare and usefulness when it is made into a reservation. The society has the hearty endorsement of the National Parks Association, the United States Biological Survey, the American Museum of Natural History, the National Association of Audubon Societies, the Ecological Society of America, the American Game Protective Association, the State Geological Survey of Georgia, the Cornell University Departments of Zoölogy and Entomology, and many scientists and nature lovers throughout the country. The president of the society is Professor James G. Needham, of Cornell University, and the secretary, Dr. J. F. Wilson, of Waycross, Georgia. All lovers of wild life and natural beauty may do their bit for the cause by becoming members of the society and keeping posted on its activities.

One of the first aims of the society is to secure certain representative portions of the swamp as the nucleus of a reservation, to which additions may be made as rapidly as opportunity or funds permit. The prospects of state or federal aid, especially in the immediate future, are quite uncertain. Therefore, at the present critical stage in the history of the swamp, the one certain way of preserving at least a part of the Okefinokee in a natural state is by the use of sufficient private funds. The Okefinokee Society is accordingly prepared to undertake the raising of such funds. The society plans, after securing the area for a reservation, to present it to the United States Government, in order that it may be administered and perpetuated as a national wild life refuge. In conclusion the complete commercial exploitation of Okefinokee Swamp would be an incalculable loss to science and to the nation, just as its preservation in its present state would be a lasting benefit to the whole country.

Two of the three great swamps of the Atlantic seaboard, the Dismal Swamp and the Everglades, have already been changed by man beyond the hope or possibility of preservation in a natural state. Let us act now, before it becomes forever too late, in behalf of the Okefinokee.

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LONG-LEAF PINES ON BILLY'S ISLAND, OKEFINOKEE

The origin of the name "Billy's Island" carries back through the romantic history of the Okefinokee. From the island's seclusion Billy Bowlegs, Indian Chief, defied the armies of the United States which sought to remove the Seminoles from the land of their fathers.

In recent years Billy's Island was the home of pioneers who, in the freedom of the wilderness, drew a plentiful if somewhat primitive, livelihood from its manifold resources. Its sandy loam produced their crops of corn and sweet potatoes, while deer, bears, raccoons, opossums, rabbits, squirrels, fish, soft shelled turtles, and wild turkeys supplied the viands for their table, and the pelts of alligators, bears, wildcats, and otters furnished a medium of exchange with the outside world. Out of the tops of the pines growing about the cabins of these pioneers, sometimes, in the absence of the men, the women shot black bears after they had been treed by the dogs

THE EARTH'S SPRING CHOIR

WITH PORTRAITS[1] OF SOLOISTS AND CHORISTERS PHOTOGRAPHED AT NIGHT BY THE AID OF FLASH LIGHT

BY FRANK OVERTON

IN MARCH AND APRIL JOYOUS PIPINGS PROCEED FROM EACH SMALL WOODLAND POOL

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[1] The quite marvelous and wholly unique photographs from life by Dr. Overton, which it is a great satisfaction to reproduce in NATURAL HISTORY, represent eleven species of toads, tree frogs, and frogs. The pictures were taken during a period of ten years about the ponds and marshes of Long Island, New York—with the exception of that of the American toad. They could be taken, of course, only in the early spring months, and as the animals are for the most part nocturnal in habit, only at night. They cover the entire Salientian fauna of the northeastern and middle eastern United States, with the exception of the northern mink frog, *Rana septentrionalis* Boulenger, the tree frog *Pseudacris feriarum* (Baird), which finds its northern limit in New York and Connecticut, and the two local races, *Hyla andersonii* Baird and *Rana virgatipes* Cope, of the New Jersey and Carolina coastal area.

The records of air and water temperatures and in most instances the times of first appearance are from the research work (*North American Anura,* 1914) of Dr. Albert H. Wright, of Cornell University, and for the latitude of Ithaca, New York.

SPRING PEEPERS "BLOW THEIR BUBBLES"

If voice among the Salientia were proportionate to size we should judge on hearing the call of the spring peeper (*Hyla crucifer* Wied) that it came from a very large frog instead of from a tiny creature an inch or less long, often little larger than one's thumb-nail. The peeper sings from concealment by day. We may stand motionless on a tussock of grass out in the marsh, while the sounds come from right and left, even from about our very feet, and search long and diligently without seeing one of the singers. But at night they clamber and swim about and are easy to locate by their voices. Like all other toads and frogs they are not afraid of the lantern. They contiuue enthusiastically to "blow their bubbles" in face of it, or even during the explosion of the flash light. What looks like a bubble is a throat pouch, so thin-walled that it is transparent, which the frog can distend with air through openings in the mouth (which is kept closed). The pouch acts as a resonator to increase the volume of the sound.

The peeper usually appears in late March, the first species to come from hibernation. It is inured to an air temperature as low as 41 degrees Fahrenheit, with average maximum temperature about 51 degrees. Peepers remain in the water many weeks before they scatter over the ground of the woods and meadow. The chorus is likely to be at its loudest about the first of May. The calls are high-pitched, clear, and penetrating, often carrying on the night air over open level country for nearly half a mile. Each call consists usually of two tones, the first lower, and sliding into the second. The calls of the different singers alternate irregularly in a loud jangle like that of sleigh bells

ONE OF THE EARLIEST TO AWAKE FROM HIBERNATION

The delicately modeled wood frog, *Rana sylvatica* Le Conte, is one of the smallest (two inches long) of the genus *Rana* in North America. It is adapted to the same low air temperatures as the peeper, and comes out from its winter sleep under logs, dead leaves, and moss in the woods in late March or early April, almost simultaneously with the little *Hyla* and the leopard frog, or at least only a few days afterward. It immediately finds its way to the pond—which probably is the pond of its ancestors—and its croaking becomes a conspicuous sound of the night

RIPPLES CIRCLE OUT AS THE THROAT AND VOCAL SACS EXPAND

The wood frog croaks while floating and swimming; the individual call is short and explosive. A chorus heard at a little distance—it does not carry far—may sound like the clucking of barnyard ducks. At this early season the only frog calls to be heard with which the wood frog's croaking might be confused are those of the leopard, which are much louder, more prolonged, and lower in pitch. After a few days in the pond, wood frogs leave the water not to return to it until another spring. They live in the shade of trees and shrubs among the dead leaves, mosses, and wild flowers that carpet the woods floor, burrowing underneath if the surface drought becomes great and when the cold of late autumn comes. The tadpoles develop into the adult form the first summer, as do those of the pickerel and leopard frogs, of the toads, and of the tree frogs.

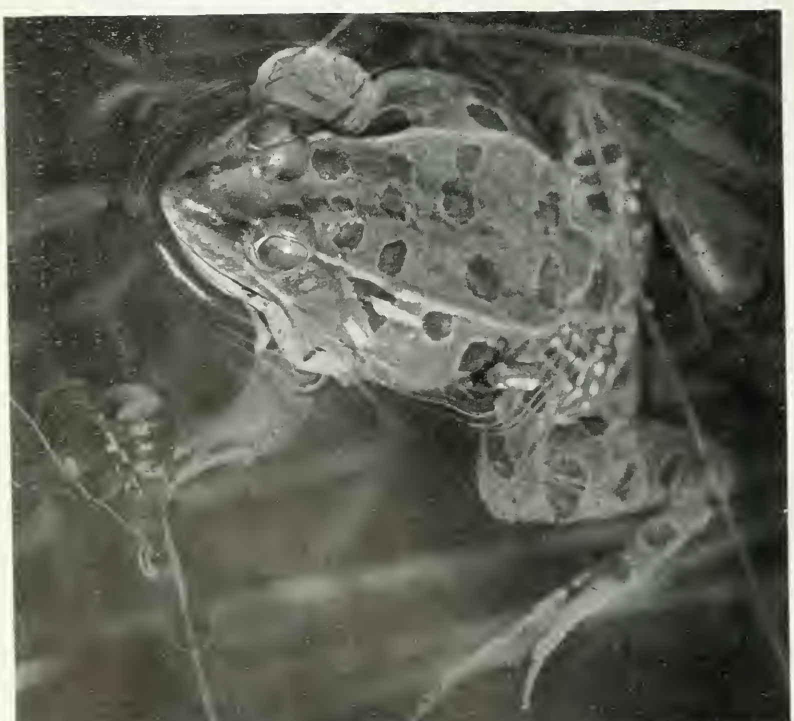
A FROG THAT OFTEN SINGS SUBMERGED

This, like the toad, is a great ally of the farmer, and it is our most common frog in North America, the leopard frog, *Rana pipiens* Schreber, yet few of us have ever seen it croaking. It often gives its prolonged snoring notes from the bottom of the shallow pond (agreeing in this with pickerel and green frogs). The leopard frog's voice is especially musical in quality; the croaking may be roughly imitated by vocalizing deep in the throat the two syllables, "ker-rock," or rather "ker-r-r-r-ock." If the frog sings submerged, of course the nostrils are kept closed as well as the mouth, while air is forced through the vocal cords back and forth between the lungs and the vocal sacs. These, like two great bubbles, alternately swell out and collapse at the sides of the head.

The leopard frog is adapted to the same low air temperatures as peeper and wood frog, and appears in late March almost simultaneously with them (usually between the two), although its voice may not be heard until a week later, when the temperature has risen to about 50 degrees. Frogs are less highly developed for life on land than toads and are more dependent on the presence of water, yet the leopard lives for long periods during the summer and fall months wandering through meadows and fields, along the roadways, or even into gardens in search of insects

THE HUMBLEST MARSH IN SPRING INVITES STUDY

Probably most people know that the conspicuous choruses of sound that issue in spring from wet meadow or marshland, pond or river margin, are made by frogs or toads of some sort. But perhaps not a large number of people recognize the notes of the different species and know what each singer looks like—which is so common a knowledge in our country in regard to the birds. The pleasure and satisfaction are not small, however, that come to those who do know them—especially if the knowledge has been gained clue by clue each spring by personal original investigation—in the spirit that Louis Agassiz taught



CROAKING LEOPARD FROG

With vocal sacs distended (photograph above) as the call proceeds, and collapsed (below) as it stops

There are three great groups of musicians among the earth's creatures, lower than mammals, performing at different seasons of the year: the Salientia, or toads and frogs, singing in early spring, birds making up the great chorus of song in late spring and early summer, and instrumentalists (Orthoptera and cicadas) among insects performing in vast orchestras during the summer and autumn. We are not surprised at the work of these insect instrumentalists, for evolution has carried these small creatures of instinct so far that their complexity of structure and behavior taxes the interpretation of man; besides, in no case has there been developed among insects a true voice. Neither are we surprised at the high perfection reached by the whistling, singing voice in the race of birds. It is paralleled by many other items of bird structure and behavior quite as wonderful. That the frogs and toads, however, still showing, by a greater or less dependence on moisture throughout their existence and by metamorphosis from an aquatic larval stage, their rise from fishlike and other voiceless aquatic forms—that these lowly creatures should have any considerable development of true vocal powers is one of the marvels of evolution. And the development is considerable: the sound is produced by control of vocal cords in the larynx, as in man; it is variously increased by means of resonating sacs; the range of pitch is rather wide; any species can be identified by its calls or songs; in fact, for the Salientia themselves, their voice is a means of recognition and communication, and for man it is among the safest of characters on which to found species identity in this group of animals

THE AMERICAN TOAD SINGS

From the bank or from shallow water the American toad, *Bufo Americanus* Holbrook, sends forth its prolonged musical trill. When the call is given with full force, the pouch becomes nearly twice the size shown here and distinctly two-lobed because of pressure of air from the two openings which lead into it under the tongue; also, the call takes on a dual character as if it were a combination of a whistled high note and a droned low one. This toad song has a quality of sweetness perhaps unequaled in nature in the spring except by the song of the bluebird and the spring notes of the chickadee.

The American toad is not inured to the low temperatures endured by peeper, leopard frog, and wood frog. It follows them, emerging in early April, when the lowest maximum air temperatures are from 53 to 57 degrees Fahrenheit. It does not sing actively in chorus, however, until the temperature of the air is about 10 degrees higher than this. By the end of May, American toads wander away into the adjoining fields and gardens, even into city streets where they seek insects under the electric lights

HIS SONG MAY SOUND LIKE AN INDIAN'S WAR WHOOP

Fowler's toad, *Bufo fowleri* Garman, appears in the ponds about two weeks later than the American toad and vigorously announces its presence by its loud cry. This is not trilled as is the call of the American toad, and is metallic in quality. It begins high in pitch but descends three or more intervals before its close. A few individuals are likely to remain in and about the ponds until midsummer, so that the call, reduced to a melancholy wail in comparison with its earlier vigor, may be heard after all other Salientian songs have ceased—except perhaps an occasional "jug-o-rum" of the bullfrog

FOWLER'S TOAD—IN THE SHALLOW WATER OF THE POND AT NIGHT

His eyes shine in the darkness, the pupil fully expanded to take all advantage of the night's weak illumination

STUDIES OF FOWLER'S TOAD "SINGING"

These photographs from life illustrate well that the toad's fear instinct is wholly in abeyance notwithstanding the proximity of camera, photographer, and flash light. These portraits are so sharply focused that they might well serve as detailed structure studies of the species. Fowler's toad can always be distinguished from the American toad, which for a large part of the range occupies the same territory, even being found in the same ponds, by the following comparative characters: Fowler's toad is likely to be smaller, grayer, and more slenderly built than the American toad; the parotoid glands at the shoulders are long and narrow with nearly parallel sides instead of kidney shaped; these parotoids are not connected with the bony cranial crests by a stemlike crest as in the American toad; the wartlike tubercles on the back are relatively small with several aggregated in each of the dark spots of the color pattern; the under surface is not conspicuously spotted, etc.

MOST RARELY SEEN OF ALL THE FROGS AND TOADS OF EASTERN NORTH AMERICA

The spadefoot toad, *Scaphiopus holbrookii holbrookii* (Harlan), is so nocturnal and so secretively subterranean in its habits that even naturalists who are on the lookout for it may not see it for years at a time. It comes out from its burrow and seeks the neighboring pond some night after a hard warm rain at any time between April and September and returns to its burrow one or two days later. The spadefoot's voice is a noisy "ker-r-raw," like the frightened cry of a barnyard fowl caught at night. It often "sings" while sprawled out on the water and the distended vocal sac is like an enormous pearly white balloon which buoys up the creature's head. It may sing with its eyes closed, as illustrated in a large series of photographs similar to the above. Very few detailed observations have been made on the spadefoot and there is much yet to be learned about its habits and life history

A singing pickerel frog, *Rana palustris* Le Conte.—This species is unusually shy and wild and spends much time in hiding, thus differing from the leopard frog, which it rather closely resembles in color pattern. (It can always be distinguished by the squarish shape of the spots, and by the bright orange color on the under surface of the thighs, displayed when the frog makes a flying leap.) It differs fundamentally from the leopard frog in its reaction to temperature, agreeing more nearly with the American toad. It does not awaken from hibernation as do leopard and wood frogs and peeper, at about 41 degrees Fahrenheit, but continues torpid until the water registers from 45 to 53 and the average maximum air temperatures are from 58 to 67. Not until some time in April, usually early in the month, are we likely to hear its voice. The call is low pitched, irregularly vibrant, less prolonged than that of the wood frog, and of less carrying power. The vocal sacs, one at either side of the head, are small and covered with thick skin

The cricket frog, *Acris gryllus* (Le Conte), is an actively jumping creature, smaller even than the spring peeper (shown nearly twice natural size in the photograph). Its vocal performance combines a musical element of considerable carrying power and a rattle. It is given in three phases: a loud "clink, clink, clink . . . . " which changes to "click-e-ty, click-e-ty, click-e-ty . . . . " with the rhythm of the hoof beats of a galloping pony, and a trilled "cree, cree, cree . . . . " somewhat like the call of a true cricket. In a chorus by many frogs all these sounds are combined into a confusion like a rattling of pebbles when heard near at hand, and at a distance like the musical jangle of small sleigh bells. Cricket frogs appear in April and may be noisy during much of the month of May

A sound like the "plung" from the plucked string of a base viol explodes from his yellow throat. This call is so very explosive in character and ends so abruptly that the photographer must snap the camera at the very beginning to get a picture of the distended throat. The green frog, *Rana clamitans* Latreille (about two thirds natural size in the photograph), may make his first-spring appearance in April, less than a week after the pickerel frog, when the lowest maximum air temperatures are from 54 to 61 degrees and the water temperatures from 46 to 58. He does not join the spring choir, however, until the temperature is still higher, in May, about a month later. This species, when startled, leaps into the water with a high-pitched scream (a sound made possibly with the mouth open as in the case of the loud scream of the bullfrog). Tadpoles of the green frog do not change to the frog form until they are one year old

A famous "rain prophet"—the common "tree toad" or, more properly, tree frog, *Hyla versicolor versicolor* (Le Conte), wakens to activity at a much later date than any other frog or toad except the bullfrog. There is required an air temperature of about 58 degrees with average maximum temperatures of from 66 to 70 before it rouses from hibernation; therefore its voice is not often heard before some time in May just when the bird chorus is reaching a maximum. After this species leaves the pond in June, it lives on the trees of the woods or the orchards or on trees and vines about the house. It gives its loud, resonant trills frequently when the air is moist, even as late as October, and is silent during dry spells, and has thus gained its name of "rain prophet." The vocal pouch may be distended to great size and vibrates forcibly during the trilling

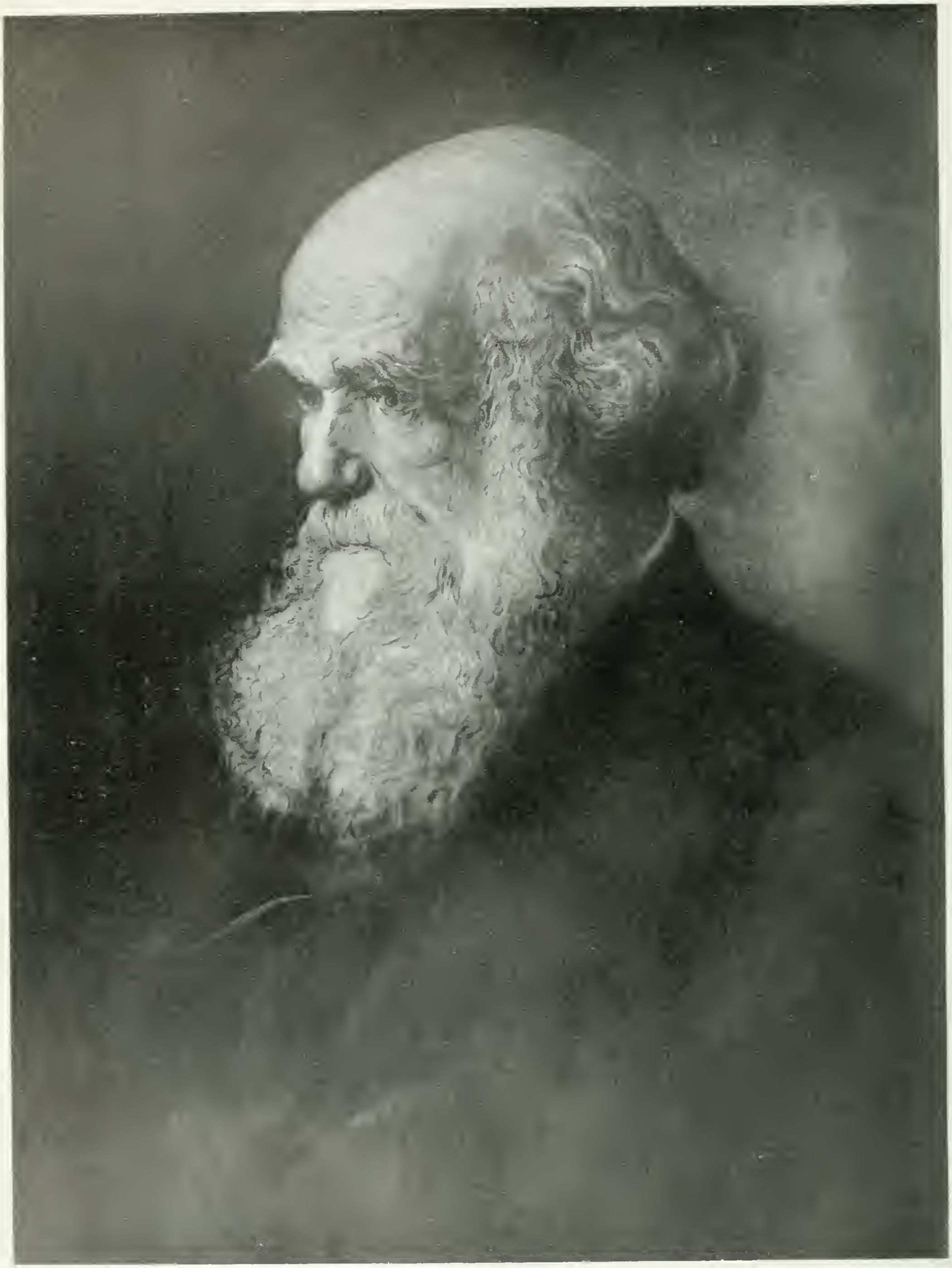
WHERE BELLOW THE SOUNDS "BE DROWNED," "JUG-O-RUM," "BR-WUM"

The bullfrog is our most aquatic species, not frequenting the shallow marsh and small pond with green and leopard frogs, but seeking out the deeper waters of river margin, lake, or pond. Bullfrogs probably never leave the water to seek a new haunt unless driven by some catastrophe. The tadpoles do not pass through the metamorphosis to the frog form until they are two years old

THE GIANT AMONG NORTH AMERICAN FROGS

The development of hearing in the Salientia has proceeded along with the development of voice. The bullfrog agrees with its near relative, the green frog, in the great size of the external "ear," the circular tympanic membrane behind the eye

The sonorous base notes of the bullfrog, *Rana catesbeiana* Shaw (photographed about one half natural size), are given with such intensity that the whole body of the frog vibrates and throws the water into minute waves. He is the last musician to enter the spring choir. He does not appear until late May, often the first of June, when water temperatures are from 57 to 69 degrees Fahrenheit and the lowest maximum air temperature is 68. We have four frogs in eastern North America which may be designated water frogs: the bullfrog and the green frog, the pickerel and the leopard. These hibernate under water and the time of their emergence thus depends on the temperature of the water rather than on the temperature of the air. Each species of the Salientia, toad or frog, of land or water habit, has its particular reaction to temperature and its especial time for emergence. Therefore under normal conditions the species would follow one another in a definite and unalterable order. Conditions, however, are not often normal. An early spring brings out the late forms prematurely together with the early, and a late spring delays the appearance of the early species so that they may appear simultaneously with those due later. Thus the spring choir is varied from year to year



THE AUTHOR OF DARWINISM

From a proof etching by G. Mercier, published in 1890, after the painting from life by W. Ouless, R.A., made in 1875

Darwinism came into existence about sixty years ago on the publication of *The Origin of Species*, in 1859, and its acceptance by a large part of the intellectual world. Darwinism is a method of evolution, not evolution itself—that had been recognized long before. Darwinism is an explanation of evolution through "natural selection" and the "survival of the fittest"; it gave for the first time a working hypothesis to the naturalist

Sixty Years of Darwinism

A LOOK BACKWARD AND FORWARD

Molluscan shells of the sea-beaches and ocean beds of the millions of years of the past suggest that evolution works gradually and continuously along definite controlled lines.—A field for future research

By AMADEUS W. GRABAU

Formerly Professor of Palæontology, Columbia University

SIXTY years ago Darwinism was born, after a period of gestation which had lasted about twenty years. The scientific world was divided in its opinion respecting the vitality of the infant,—the religious world was hostile to the newcomer, regarding him as a false messiah come to destroy, not to save, while the intellectuals who professed allegiance to neither camp were divided in their attitude,—some saw in his advent the promise of a new dispensation, others voiced their scorn of his pretensions in ridicule. Listen to the scoffers:

"A deer with a neck full longer by half
Than the rest of his family, try not to laugh,
By stretching and stretching, became a giraffe.
Which nobody can deny."

Now it happens that this has reference, not to Darwinism, but to a much older child of the naturalist Lamarck. This, however, the scoffers did not appreciate. The trouble with the average man was then, as it is now, that he confused Darwinism with evolution. To continue our metaphor: Evolution was not born but, like Topsy, "just grew." Aristotle knew about it, or thought he did, and other philosophers before and since his time have tacitly assumed its existence and speculated about its nature. Goethe, Buffon, Saint-Hilaire, Lamarck, and the grandfather of Charles Darwin talked and wrote about it, but of its real character they had, as a rule, only a hazy conception.

Darwinism Is a Method of Evolution

Darwinism is not evolution, it is a method of evolution. So is Lamarckism, and so is orthogenesis. Darwinism attempts to explain evolution, to find a natural cause for it,—evolution itself it takes for granted.

But while Darwin did not give to the world the idea of evolution, he was the first to marshal an overwhelming array of facts which clearly admitted of no other interpretation, and to present them to the intelligent in such a way that they could not honestly refuse to consider their philosophic import. Moreover, he was the first to offer to the working naturalist an explanation of the method of evolution, and to establish the existence of a law that by a process of natural selection those best adapted to their environment would alone survive.[1] As Huxley says, "up to the time of the appearance of Darwin's *Origin of Species*. . . . the evidence in favor of transmutation was wholly insufficient, and no suggestion respecting the causes of the transmutation assumed which had been made, was in any way adequate to explain the phenomena."

"The suggestion," Huxley goes on to say, "that new species may result from the selective action of the external con-

[1] It is of interest, however, that Darwin was not the only discoverer of the law that by natural selection the unfit are eliminated, and the fit preserved. Alfred Russel Wallace had independently discovered the same law, and both discoveries were announced to the scientific world at the same time. Herbert Spencer, too, before this, had appealed to the survival of the fittest as a means for progress in the organic world.

ditions upon the variations from their specific type which individuals present, and which we call 'spontaneous' because we are ignorant of their causation, is as wholly unknown to the historian of scientific ideas as it was to the biological specialist before 1858. But that suggestion is the central idea of the *Origin of Species* and contains the quintessence of Darwinism. . . . That which we were looking for and could not find was a hypothesis respecting the origin of known organic forms which assumed the operation of no causes but such as could be proved to be actually at work. We wanted, not to pin our faith to that or any other speculation, but to get hold of clear and definite conceptions which could be brought face to face with facts, and have their validity tested. The *Origin* provided us with the working hypothesis we sought. . . ."

What then is this quintessence of Darwinism, this doctrine of natural selection, which led to such a general acceptance of the theory of transmutation of species, by a considerable portion of the intellectual world?

The Weeding Out by the Environment Is Natural Selection

In the first place, we must disabuse our minds wholly of the very general notion that natural selection is an entity or a force that does something. Such figures of speech as "Natural selection weeds out the unfit," "Natural selection preserves the fittest," and others like these, are misleading. Natural selection is not a force, it is a process. The weeding out by natural means of the unfit *is* natural selection; the preservation of the fittest in the struggle for existence is their selection in nature for survival. What then, you ask, is the agent or force that does the selecting in nature? To this we answer: The environment, using that term in its most comprehensive sense. To illustrate: A boat filled with human beings capsizes. If each thinks of himself alone, those who can swim and are strong enough to reach the shore, will survive; those who cannot swim will drown; while those who can swim but are not strong enough to resist the shock and exposure, will also perish. Thus the ones adapted to at least temporary existence in that particular environment will survive. That is natural selection. If one of the men remembers that a beloved companion cannot swim, and saves that companion in preference to others, he performs an act of artificial selection. If the boat capsizes in the open ocean and no help is near, all must perish, for the adaptation is not sufficiently complete.

Another illustration: A caravan in a desert has a limited supply of water, sufficient to support only one half the number adequately until the next water hole is reached. The stronger or more cunning might seize the water and leave the rest of the caravan to perish. That would be natural selection. Being human, however, they all share the inadequate supply, and all perish, or reach the water hole in an enfeebled condition. Natural selection has been interfered with at the physical expense of the entire caravan. What is gained is beyond the forces operative in natural selection.

Again: Two deer are surprised by a hungry wolf. The more alert of the two and the swifter of foot escapes, the other is devoured. Natural selection has taken place on the basis of alertness and of swiftness of limb and foot. The fittest in these respects survives. The English sparrow drives out the native song birds. The sparrow is physically more fit to survive, but æsthetically it is a poorer type of bird. Thus the fittest is not always the best from another point of view.

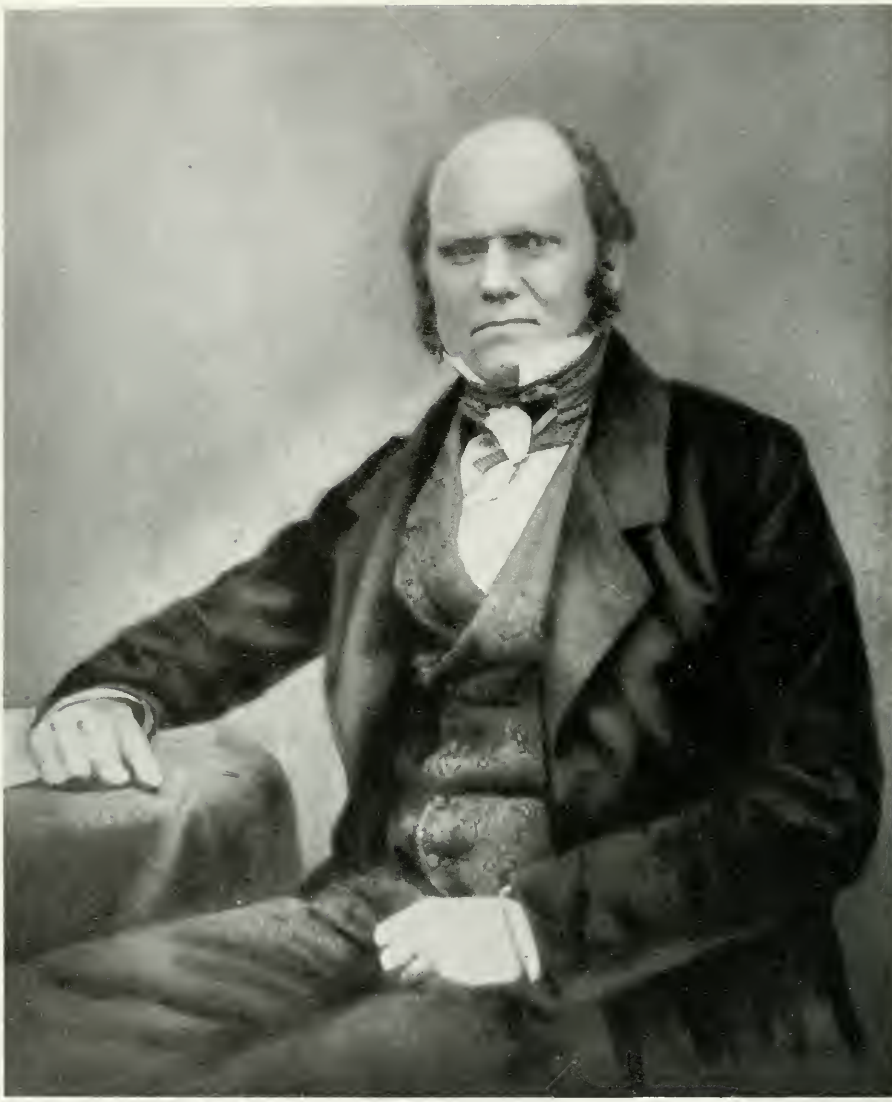
In a state of nature, the strongest and most cunning, who can get the food supply, the ones best capable of resisting the attacking enemies, escaping from them or eluding them by deception or otherwise, those immune from diseases which destroy the others, those capable of withstanding great changes of climate or nullifying their effects by periodic migration to milder regions, by burrowing in the ground, or otherwise, those capable of resisting drought by storing up water, as do the cacti among plants and the camels among animals,—in short, those that can withstand best all the destructive agencies in nature, and can gain their requisite supply of food, those are the fittest, and they will survive. Civilization, on the other hand, succors the weak, feeds the hungry, clothes the naked, and natural selection is not operative,—the physically unfit survive.

The Process of Natural Selection Works in Other Ways

Natural selection, however, takes place in other ways as well. What determines that of two women grinding at the mill, one shall be taken and the other left? The choosing of a mate in human society not infrequently depends on psychic rather than on physical qualities; on the beauty of the soul, rather than the beauty of the body, although physical characteristics, among which we may class the possession of wealth and the social standing it implies, form too often the basis of selection. Physical characters to a certain extent also form the basis for "sexual selection," as it is called, where this takes place among animals in a state of nature. Here, often, special characteristics, such as bright plumage or song among birds, various ornaments or accomplishments in other animals, —attributes regarded as attractive to the opposite sex,—are developed by the members of that sex which furnishes the candidates for selection. There is, however, good reason for the belief that many, if not most, of the characters commonly regarded as significant in sexual selection, are merely expressions of sexual maturity on the part of the more virile sex. Here, probably, belong the antlers of the stag, which, although used in fighting among the males at the mating season, can hardly be regarded as primarily developed in response to the fighting propensity, which is itself an expression of sexual virility. For, if so, how are we to account for the fact that the antlers become fighting weapons only when their growth is completed, and when the easily injured coating of "velvet" has served its function and is discarded; and how are we to account for the seasonal shedding of the antlers themselves, when the period of sexual excitement has passed?

Special characters of form and color are developed in the males of some fish, for example, which never mate with the females, but separately fertilize the eggs cast off by these. Among animals as among men, propinquity probably plays the largest rôle in influencing the choice of a mate, but it is no doubt true that the offspring may be powerfully affected by the greater vitality expressed at the height of sexual maturity of the parent, by the development of the brightest plumage, by the most complex and powerful antlers, by the most involved of dances or other antics among animals, or by the flashing eye, the heightened color, the daring deeds, the quickened intellect, and roused emotion which bursts into song or rhapsody in the human species. These characters are, however, the expressions of a condition rather than a means towards an end, although it is probably true that they may have an influence in bringing together physically and psychically attuned individuals, and so work for the betterment of the race.

It is otherwise when man consciously determines the mating of those subject to his control. Man breeds animals and plants for definite characters useful to him, or fancied by him, by se-



CHARLES DARWIN, PORTRAIT OF 1854

Photograph from life made by Maull and Fox, London, in 1854. Half tone from a print owned by the New York Academy of Sciences, from the restored negative

Darwin's observations and studies made him believe in the potency of the environment in giving direction to evolution. He observed that all creatures of a kind vary in minute ways from one another as their birthright, and he believed that where the variations were in harmony with the conditions of existence those animals naturally were preserved, to hand on by heredity the favorable variations.

The Darwinians of today (Neo-Darwinians, they have been called) are followers of Darwin who go farther than their master in saying that the organic world alone progresses by natural selection of such variations, minute and fortuitous (congenital but not controlled by any known law). There are many, however, who have questioned that these minute fluctuating variations have sufficient importance to be used by selection. Among these are the followers of De Vries (whose experimental work has been on plants), who believe in evolution by sudden jumps, by "mutation." Darwin at one time attached great importance to such sports, but finally relegated them to an inferior place

CHARLES DARWIN, PORTRAIT OF 1881

Half tone from a photograph from life, property of the New York Academy of Sciences, made by Elliot and Fry, London, in 1881

A man whose name and memory the world will honor to the end of historic time—for his industrious, laborious study, his clear reasoning, original thinking, and bold stand for scientific truth lecting the parents with that end in view. This is termed artificial selection, and to it is due the wonderful variety of domestic races of animals and plants. It was, indeed, the study of artificial selection as practiced by the breeder that led Darwin to an appreciation of the selective process in nature, and, in the investigation of this obscure problem of ". . . the means of modification and co-adaptation," he invariably found "that our knowledge, imperfect though it be, of variation under domestication, affords the best and safest clue," and he begins his great book *The Origin of Species* with a chapter on "Variations under Domestication" and the principles of selection by man.

But it is not only with domestic animals and plants that man performs the selection of mates; he not infrequently does this for his own offspring as well. And here he too often follows principles that as a breeder of fine animals he would scorn. The orthodox Jew selects for his daughter a prosperous man of business when he cannot obtain a bridegroom learned in the law. The aristocratic rulers mate their children for political reasons, and the socially ambitious mother sells her daughter to the highest bidder, regardless of his physical, mental, or spiritual fitness. Fortunately for the race, the scheming parent in this last instance is sometimes thwarted by the spirited daughter, who makes her own selection on a higher plane, unmindful of immediate consequences. It is in the modern science of eugenics that the standard of selection is scrutinized, and that the process is elevated to the level which insures to the future the survival and perpetuation, with constant improvements, of the truly fittest.

Variation or Lack of Equality Is Preliminary to Natural Selection

Without much reflection on the matter it will be seen that selection can take place only if there is diversity of characteristics in the organisms from which selection is to be made. If all animals of a group were alike in every respect, if all men were truly equal, survival would be a matter of accident. Thus variation is a necessary preliminary to selection. But variation must be sufficient to have a selective value. A slight increase in the length and slenderness of the leg may insure sufficient agility to enable its possessor to outdistance his comrades and so escape from the pursuing enemy to which the others succumb. But how about an extra minute spot on the wing of a butterfly, or the union of two spots on the wing cover of a beetle? Will a hungry bird stop to count the spots or note their arrangement in selecting its prey? Evidently there are variations which have a selective value, and those which have none. To be sure, the extra color spot or the bar may be a character which appears only as companion feature of, or in correlation with, some other variation, such as greater power of evasion and the like, which is the real character that insures survival. Thus the slightly different insignia on the shoulders of an officer's uniform do not protect him from the enemy's bullet. As an officer, he is commanded to use greater caution and seek better protection. The shoulder insignia are merely a correlative variation of the variation in rank, between him and the private.

But, in the belief of many naturalists, minor variations are not always nor perhaps generally to be classed as correlative of others which have a selective value. That they exist admits of no doubt; indeed, it is on the basis of such minor variations that species are established. We may never agree on what amount of variation is necessary to produce a new species,—in fact, no two naturalists ever do agree wholly on this point; we may, indeed, be convinced that nature knows no species, only individuals, but we all agree that variations do exist in nature, and that in fact no two individuals are ever exactly alike. Moreover, we recognize that most variations are congenital: that is, they are part of the endowment of the organism at birth, its birthright or birthcurse as the case may be. And we have further learned that characters which appear as the result of such variations may be handed on to posterity unto the third or fourth generation, or, if they subserve the divine command of nature, even unto the thousandth generation. Whether characters acquired during the lifetime of an individual may be transmitted to the offspring is still a mooted question, but with such characters we are not now concerned.

We are by no means in agreement, however, as to the nature of congenital variations; are they definite or indefinite, continuous or discontinuous, gradual or abrupt? Darwin believed in minute fluctuating variations about a mean, and that, by selection, those individuals which happened to vary in a favorable direction, that is, in a direction most in harmony with the environment, would be preserved, and so hand on the favorable variation. Further variation about this new mean, and continued selection for favorable characters, would in time produce the specialized and highly adapted types, the favored few, fit to survive out of a multitude doomed to extinction. This is the gospel of accident, the doctrine of fortuitousness, and it is the cardinal doctrine of the ultra-Darwinians, those followers of Darwin who, unlike their master, see in natural selection, on the basis of favorable but fortuitous variations, the sole means of progress in the organic world.

Theory of the Neo-Darwinians Based on Minute Fortuitous Variations

Darwinism then, in the sense of the modern followers of Darwin, the Neo-Darwinians as they have been called, is the doctrine, that the environment destroys the unfit and preserves the fit—natural selection takes place; that the essence of fitness is adaptation to the conditions of existence—the best adapted will survive and hand on to their offspring those characters which have made them fit; and finally, that these character arise as the result of fortuitous variation: that is, variation apparently uncontrolled by any known law.

But the environment, too, is constantly changing; the Garden of Eden becomes a desert, roses bloom on the site of a prehistoric Sahara. "There rolls the deep, where grew the tree. . . . There where the long street roars hath been the stillness of the central sea." Adaptations, which under one environment insured survival, under changed conditions spell death. The *Megatherium,* the last of a long line of ground sloths, and well adapted to the food of its native haunts, became enfeebled as this food supply diminished in consequence of a change in climate, and so fell an easy prey to its chief adversary, the saber-toothed tiger. The sabertooth, in turn, fitted with tooth and claw adapted to hunting and stabbing to death these slow-moving thick-skinned herbivores, faced starvation when the last *Megatherium* was devoured, because from over-specialization this cat had lost plasticity to adapt itself to the swifter-footed grazing animals which formed the prey of its more agile cousins, the true tigers, the lions, jaguars, and the other great biting cats which still survive where man, their principal enemy, permits it.

The struggle for existence denies opportunity to the unfit: always and everywhere the fittest alone survive, always and forever the weak go to the wall. That is Darwinism pure and simple. Hope lies in a changing environment,—the fit today become the unfit tomorrow. The law of the jungle cannot survive the jungle—the militarist cannot survive in a nonmilitaristic age—nor the Bolshevist the restoration of the reign of reason. When the environment of common sense is reestablished, the worker and the capitalist each again will find his place, and the advantage to all will be seen in the development of those qualities and powers which will make the unfit of today fit to fill their proper place in the united army of struggling humanity. That, too, is Darwinism.

Selective Value of Fortuitous Variations Questioned

But, I repeat, Darwinism is not the sole factor in evolution, at least not in the belief of many students of nature. To begin with, the value of fortuitous variations as a basis for selection is seriously questioned by many who cannot accept minute changes in form and character as of sufficient import to determine survival. Color harmony with the surrounding habitat may protect the animal by deceiving its enemy, the camouflaged ship has a chance to escape the lurking submarine, where the one not thus protected will be lost, but such adaptations are not small, they are large variations from the normal. A single stripe, the first step in the production of the protective design upon the vessel, will not serve the purpose of deceiving the enemy any more than a single green spot would serve a brown *Mantis* upon green grass, or the first step in the development of a pattern which makes the palatable butterfly resemble the distasteful one, deceive the hungry bird. But fortuitous variations are first steps, they are minute beginnings in the production of a serviceable whole and as such, cannot serve the purpose of the finished product. To have selective value the variation must be adequate; to become adequate it must either arise suddenly, or develop by cumulative additions in the proper directions without reference to immediate selectivity.

The attention of naturalists has of late years been directed to those larger and apparently sudden variations which are seen to arise occasionally in nature, and which are familiarly known as sports. The phenomenon is illustrated by the short-legged ram, which appeared suddenly in Massachusetts in 1791, and from which the race of ancon sheep, once prized because of their inability to jump fences, descended. Darwin at one time attached great value to such sports, but later on relegated them to a place of secondary rank.

Selection by Mutation

But when the Dutch botanist Hugo de Vries discovered sports of the evening primrose (*Œnothera lamarckiana*) in a field not far from Amsterdam, and found by experiment that these forms bred true to type, that is, they were not fluctuating, but had constant new characters, the attention of the scientific world was again directed to this phenomenon, and careful breeding experiments became the order of the day. De Vries and most of his followers became convinced that not by minute fluctuating variations about a mean, but by sudden jumps, was progress made. From causes still unknown, the elementary characteristics of an animal or a plant now and then undergo a sudden rearrangement, much as the colored glass particles in a kaleidoscope are suddenly rearranged to form a new pattern, and this new organic pattern constitutes a new elementary species. Such an abrupt rearrangement of characters De Vries called mutation, others have called it saltation, and it is generally thought of as a process uncontrolled by any known law. To the De Vriesians the new elementary species thus produced are the only variations from the type which count. They alone are subject to natural selection; they alone mark the steps in the progress of the organic world.

Study of Young Stages and Paleontology Suggest that Variations are not Fortuitous but Controlled by Law

The Darwinian and the follower of De Vries have a common starting point—they both concern themselves with adult individuals. The voice of the elder Agassiz, crying in the biological wilderness of the early half of the last century, and exhorting naturalists to pay attention to the immature stages of animals and plants—those stages which lie between the embryo and the adult—has never reached their ears, or if they heard, they did not heed. But a disciple who followed the master in his wanderings through the underworld, where dead and forgotten generations of animal life had written their own epitaphs on tablets of stone, listened and learned and, by patient search among the ancient life records, became convinced that the new faith into which he had been baptized, pointed the true way to biological salvation. Alpheus Hyatt proved what Agassiz preached, that the immature stages of an animal's life history furnish the key to its racial history, that the young animal repeats the adult characters of its ancestor which lived in the immediately preceding geological period, and that this ancestor in turn had repeated in its own youthful stages the characteristics of a still earlier member of the tribe. Agassiz did not accept the doctrine of evolution, but Hyatt recognized the philosophic bearing of the facts uncovered by his researches. Step by step, the history of each individual type carried him backward in the history of the race until the beginning was reached. Down the long corridor of time he passed and took his pupils with him. Eagerly each new inscription was scanned, and each pupil selected that which to him seemed most promising, and then began to unwind the long record of ancestral achievement. And whenever the way seemed long, and their courage began to fail, new vistas would open, and the pursuit regain new vigor. And in this quest it became increasingly more apparent that variation was not fortuitous nor indefinite, but controlled along definite directions. To be sure, the controlling force has not been revealed, or but dimly so, but the very definiteness of the variation leaves no doubt as to the existence of such a control.

The study of child life and of adolescence has a fascination all its own, but its value as a guide to human evolution is only beginning to be appreciated. We are of necessity compelled to study and compare separate individuals in different stages of their development, but we ought to study single individuals in all their stages from birth to adulthood or to death. In this manner alone could we eliminate the variations due to acceleration or retardation in development which obscure the record. Moreover, the records furnished by one generation must be compared with those of preceding as well as succeeding generations to determine the trend of development of that particular genetic series. Are such studies possible? If you photograph, measure, and carefully describe the characteristics of your child, year after year, from birth to old age, and if this child performs the same herculean task for its own offspring, and this is carried on in the succeeding generations for a thousand years, a mass of data of incalculable value to the student of human evolution would result. But neither you nor I would have the patience to carry through our part of this undertaking, or if we have, our children, or our children's children would most certainly fail to continue the work, even though we could convince them of its value. But if such records were automatically kept, generation after generation, and preserved for comparison,

LOUIS AGASSIZ, 1847

He had a passion for knowing living things, and was indefatigable in his collecting and study. In this connection he wrote his father, "I feel within myself the strength of a whole generation." As was said in memorial words on Agassiz[1], in 1896, life has come kindlier to all naturalists since Agassiz lived, because he bore that name. People thought natural history must indeed be a godlike pursuit if such a man as he could so adore it

the future would hold promise that we might master the secrets of existence from these records of the past, and find the key to the solution of the problem of human life and the control of human destinies.

Is this a hopeless dream? Not altogether, I believe, for although such records will never be made for man, nor even, in completeness, for any group of organisms, they do exist and have been kept for millions of years, with reference to certain characters, in untold generations, among the lower, simpler forms of life.

Record of Mollusk Shells through Millions of Years Suggests Evolution by Orthogenesis

The shell-bearing Mollusca, the lime-secreting coral polyps, and some other lowly forms of animal life have kept this record from the dawn of their existence, and although it refers only to bodily form and proportion, it is adequate to reveal to the close student at least some of the fundamental laws which control the development of all life. No one not a palæontologist or searcher in the ancient life-records of the earth can appreciate the wonders of the empty shell which the careless stroller on the sea-beach regards with idle curiosity. Only the palæontologist can wander along the sea-beaches of the past and gather the shells of long vanished oceans, and only he can read the record embodied in the form and structure of these shells and glimpse its meaning in terms of universal law. We need a thousand students of fossil shells where today we have but a score—we

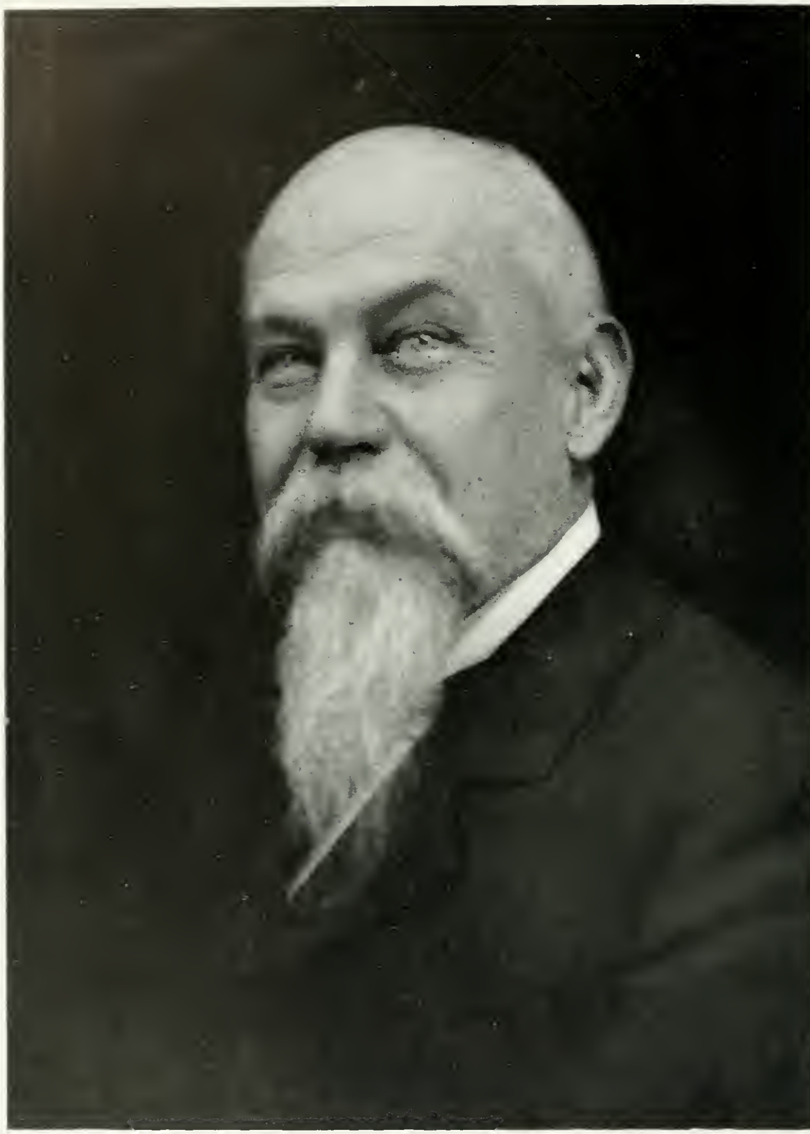
[1] "Louis Agassiz": Words spoken by Professor William James, at the reception of the American Society of Naturalists, by the President and Fellows of Harvard College, at Cambridge, December 30, 1896. *Annual Report*, Museum of Comparative Zoölogy, Harvard College, 1896-97.

LOUIS AGASSIZ, 1865

This and the portrait on the opposite page are accepted as authentic photographs, having received the approval of the family of Agassiz when they were published, on the centennial of his birth

The observations and theories of Darwin were based on adult animals. Agassiz exhorted biologists to study the immature stages of animals. He himself did not accept the doctrine of evolution, so that it was left for his students and followers to interpret the facts brought to light in such study and relate them with the new theories of the century.

Louis Agassiz's name cannot be mentioned in America without recalling his beneficial influence on the pedagogical methods then in vogue in the country. He gave a tremendous shock to the old method of committing to memory page upon page of printed facts which should be gained by observation or by reasoning. "Go to nature; take the facts into your own hands; look and see for yourself! Study nature, not books!"—such Agassiz maxims have been familiar to all laboratory students in America since his time



Portrait used through the courtesy of Mrs. A. G. Mayor

ALPHEUS HYATT, 1838-1902

Alpheus Hyatt was a student of Louis Agassiz. Under Agassiz's influence he was the first to undertake the detailed study of the post-embryonic stages in the life of the individual, chiefly in *Ammonites*. He compared these with the adults of preceding types, his first paper along this line appearing in 1866, and proved what Agassiz preached, that the immature stages of an animal's life history furnish the key to its racial history in the immediately preceding geological period. He and his students through a long pursuit of detailed palæontological studies came to a more and more decided conclusion that variation is not accidental or indefinite, but controlled along definite directions. We who work in this field today consider ourselves members of the "Hyatt School of Palæontology," a designation proposed by Dr. R. T. Jackson (formerly of Harvard), president of the Palæontological Society in 1919.

Alpheus Hyatt was at one time professor of palæontology and zoölogy in the Massachusetts Institute of Technology. He was curator of the Boston Society of Natural History Museum and curator in the Museum of Comparative Zoölogy, at Harvard College, until his death in 1902 need men and women who by careful search of the life-record of the past will lay the foundation for the superstructure of the future. The humble mollusk must become the teacher of the minister and the philosopher, of the lawmaker and the reformer: these must go to it, to learn first principles because, as keeper of the record, it guards the history of the past. You who read this, if you are new to the thought, may hold me extravagant, but I will undertake to convince you, if you will become a faithful student of molluscan shells and are not incapacitated by rigid adherence to received ideas. Leave Darwin for a while, become a follower of Hyatt, and you will return to Darwin with a truer conception of the real significance of his work.

The mollusk begins shell-building very early in life. The shell is not a mere protective covering, but an accurate replica in stone of the outline and minutest detail of form of the fleshy integument of the animal's body, a part of the animal which, like all others, undergoes progressive development. As this integument (the mantle) increases in complexity with growth, the shell records the change, records it step by step by adding the new features to the old, which are not destroyed but remain as a permanent part of the whole. Each step in development is faithfully recorded, until death puts an end to the process. But the shell is stone, its form is subject to no important changes in the course of time, barring accident, and, from the nature of the molluscan habitat, the shell survives the lifetime of its builder and becomes embedded in the sediment of the sea bottom upon which the next generation passes its existence. Successive layers thus accumulate, each with the permanent record of the life of its time inscribed upon it, and all arranged in chronologic order, the oldest below, the youngest on top.

Reading the life history of a single individual from the characteristics of the shell, we discover that the changes there recorded are not fortuitous but orderly, not in all directions but along definite lines; not by leaps but by minute gradations, each a little farther in the same direction. Comparing a thousand individuals of the same species from the same layer, we note that all undergo a similar development, all proceed, as it were, in the same general direction from a common starting point, but some go faster, others more slowly. Acceleration or retardation modifies the rate of progress, but does not affect its direction. As the number of shell-characters increases certain members of the group place the developmental emphasis upon one, others upon another character, and so divergence takes place. But each group, having begun to develop in a given direction, continues along that line with slow and progressive amplification of characters, at first minute and scarcely noticeable, but, when adulthood is reached, such characters may have become pronounced and form a basis for varietal distinction. Viewed as adults, such accelerated forms may appear to represent a kaleidoscopic rearrangement of parts, but seen by the light of the individual life history, the development is an orderly one. It is possible that when some of the examples of abrupt mutations of the De Vriesians are examined from this point of view, they may after all reveal themselves as normal types, except for certain features upon which development was concentrated to the retardation or exclusion of others.

Orderly progressive development by gradual and essentially continuous modification in definite directions is the rule in individual development, and prolonged study of the shells of successive geological periods has shown it to be the rule in racial development as well. Having started to develop in a given direction, from whatever cause, the organism continues along that line, until features are produced which can serve as a basis for selection. If the results of definite development are violently out of harmony with the environment, if by persistent evolution in a given direction the permitted bounds are exceeded, extinction must result, eliminative selection takes place. Thus the progressive development of militarism has at last exceeded the restricted boundaries set by a changing age, and so become its own destroyer. So fashions in dress and ornament progress along definite lines until in some directions the changing limits of toleration are exceeded and extinction results; selection takes place.

This progressive modification in definite directions without reference to the end results was considered by Shaler and by Hyatt as a manifestation of what they called the "Inertia of Evolution." Theodore Eimer, the Tübingen zoölogist, and one of the few of that profession who made a serious study of the existing animal life in terms of individual development, adopted the name "orthogenesis" for the principle of definitely directed development by minute continuous modifications in a few directions. But his work never led him to the study of the historic record furnished in palæontology, and so, although the credit of formulating the theory is his, its demonstration devolved on Hyatt who independently developed it although he never used the term orthogenesis.

Variation is definite: it is progressive in determinable directions; it proceeds by minute changes which themselves have no selective value, but which, because of their continuity and cumulativeness, produce those features which are either useful or harmful in the struggle for existence. Selection is not a primary but a secondary factor in evolution, progress is controlled not determined by it. That is the lesson taught by the molluscan shell.

What makes for orthogenesis? What determines variation in one and not in another direction? There are those who, like Eimer, credit the environment with this function. Hyatt was not one of them; to him, as to many of us, environment is a stimulus, not a creator. Unless the possibility of development in a certain direction is there, environment is powerless. It may determine which of several directions the organism shall follow in its evolution, but the potentiality of such evolution must be preëxisting.

The environment of the galley developed Jean Valjean into a brute, that created by M. Bienvenue made him almost a saint. Palæontology has demonstrated the existence of orthogenetic tendencies in nature, the newer Darwinism must take account of these, and apply selection to environment. The law of the survival of the fittest can never be repealed, for nature's laws are immutable. The selection of the fit environment, however, lessens the scope of its activity, by directing evolution into channels which will lead to such degree of fitness as the nature of the individual makes him capable of. Neither environment nor selection will ever produce a silk purse from a sow's ear, but under the stimulus of the right environment even the ear of the sow will develop its highest capabilities, limited though these may be.

Flying Reptiles

By W. D. MATTHEW

Department of Vertebrate Palæontology, American Museum of Natural History

The American Museum has placed on exhibition a fine skeleton of the *Pteranodon* or giant flying reptile from the chalk formation of western Kansas. It is on the fourth floor, on the west wall of the corridor diagonally opposite the elevator, and is placed between two other fine fossil specimens from the same formation, the great marine lizard, *Tylosaurus*, below, a giant fish, *Portheus*, above. The skeleton lacks the outer end of the right wing, the sternum, one hind leg, and some of the neck vertebræ, and of the skull only two fragments are preserved. The form of the missing parts is known from other specimens in this Museum and elsewhere, and these parts have been painted on the background in a color nearly as dark as the original bone. The supposed outlines of the wing membranes have been added in a lighter tint.

THE skeleton of the new giant flying reptile[1] at the American Museum, while not the largest of its kind, is of quite impressive dimensions. The wings, if stretched out in a straight line, would measure 21 feet from tip to tip; in their present curve, about their actual position in flight, they measure 16 feet between the tips. Nothing of the wing membranes was preserved in this skeleton; but in other kinds of pterodactyls they have been preserved more or less complete, so that it is known that they were thin delicate membranes like the wings of bats. The bat's wing, however, is extended upon four out of the five fingers stretched out like the ribs of an umbrella. In the pterodactyl only one finger is elongated for a wing, the membrane being stretched between that and the rather long hind legs. The wing finger was the fourth digit, and the remains of the first three digits, reduced to small claws, can easily be recognized on the upper border of the wing. The claws were probably used by the animal to hang itself up to trees or rocks when at rest, much in the same way as bats do with their hind feet.

The head is a most extraordinary part of the animal. All pterodactyls have large but lightly constructed skulls with a long beak, which in most of them is set with sharp needle-like teeth. The *Pteranodon*, as its name indicates,[2] is toothless, with a great, sharp-pointed beak somewhat like that of a stork or a kingfisher, and a very light and delicately constructed skull with an enormous compressed crest stretching backward from it, almost equal to the beak in length. It is supposed that this great crest served to balance the weight of air pressure on the beak when flying, and enable the head to be held to the wind without danger of being forced sideways by a sudden gust or a turn in direction.

The neck is moderately long and strong, as would be needed to carry the large head, but the body looks absurdly short and small and the tail is a mere little stub. The backbone between the shoulders is all consolidated into a single piece (called the notarium), just as the backbone between the hip bones is consolidated in most animals into a single piece called the sacrum. The upper end of the shoulder girdle (scapula) is socketed into the side of the notarium, the lower end (coracoid) into the sternum on the under side of the body. This affords a very strong

[1] A notice of this specimen was published in the AMERICAN MUSEUM JOURNAL for April, 1916, at the time the skeleton was purchased from the finder, Handel T. Martin.

[2] It is from *Pter-(osaurian)*, a winged lizard or pterodactyl; and the Greek *an*, without; *odon(tes)*, teeth.

purchase for the wings, stronger even than in birds, which sometimes have the vertebræ partly consolidated like a notarium, but never get so far as to have the scapula socketed into it. Nor do the smaller and more primitive pterodactyls have the shoulder blade socketed in this way, although some of them have a notarium. Of course the wing bones of a bird are not extended out so far as those of a pterodactyl, a good part of the length of a bird's wing being made by the feathers.

The breastbone or sternum is not so unlike the breastbone of a bird. It is a broad flat plate with a high crest projecting forward and downward in the middle line, to which the principal wing muscle is attached. In this specimen, unfortunately, the sternum was missing altogether.

The ribs are very imperfect, short, and little curved. Probably a considerable part of the body basket was cartilaginous, so that it has not been preserved as a fossil. The ribs in this specimen were scattered, and no attempt has been made to bring them back to their proper articulations. They have merely been placed near to their proper location.

The extent and limits of the wing membranes as shown on the specimen are theoretical. No pterodactyl of this group has been found in which they are preserved. They have been found, indeed, more or less perfectly preserved, in some of the smaller species from the Solenhofen slate of Bavaria, notably the long-tailed *Rhamphorhynchus* and the short-tailed *Pterodactylus, Scaphognathus,* etc. But these more ancient kinds of flying reptiles are much smaller and more primitive, and so different from the great *Pteranodon* in the proportions of skull and other parts that they may have been very different in the wings as well. The best evidence for reconstructing the wings is the form and proportion of the bones and the probable purposes to which they could be applied. It is difficult to see how a sufficient width could be obtained for the stretched membrane of the wings unless it were extended down along the sides of the hind legs, as Dr. Williston believed, and not merely along the side of the body, as Dr. Seeley supposed. Then if the membrane was stretched on the outer side of each hind leg, it must also have been stretched between them and up to the tail, in order to take the strain off the legs. It may also be supposed that the membrane stretched from the neck out on each side over the shoulders as far as the "pteroid bone," as this would have some obvious mechanical advantages.

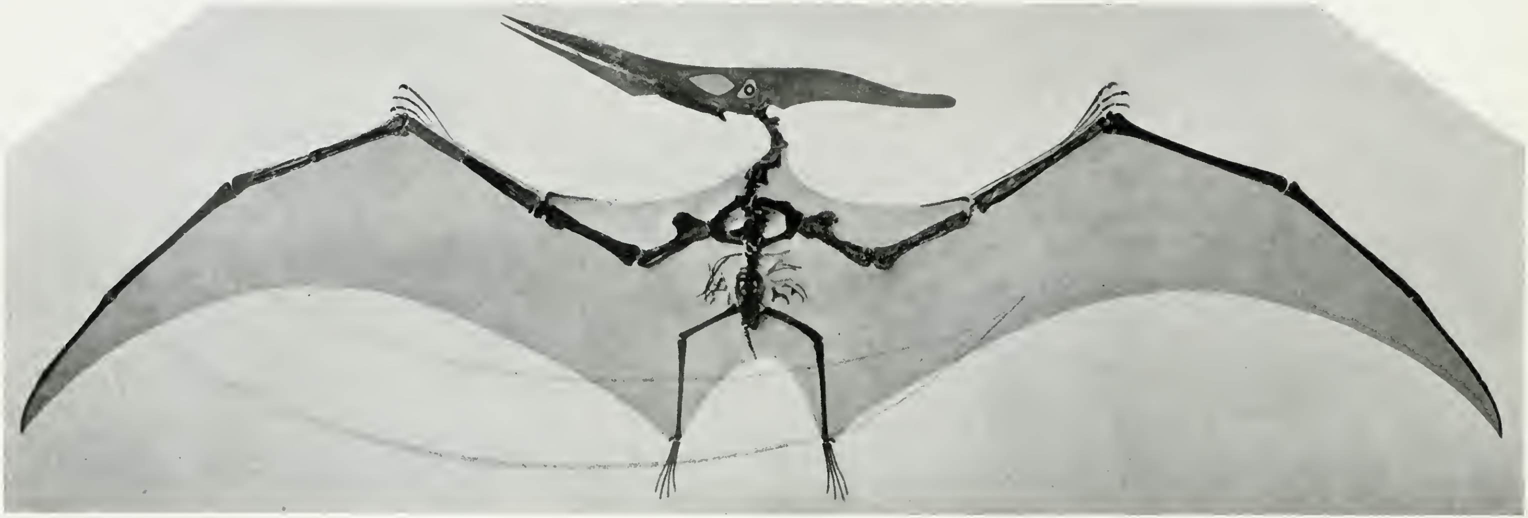
Resemblances of Flying Reptiles to Birds

In life all the principal bones of pterodactyls were thin, hollow cylinders of an exceptionally hard and flaky quality of bone. Moreover, there are, in some of the bones at least, openings corresponding to those in birds, which serve to allow air to circulate within the hollow cavity of the bone.

This is not the only point in which pterodactyls resemble birds. They have also a much higher type of brain than ordinary reptiles, the cerebellum or hind-brain is large, and, as in birds, the optic lobes are widely separated. It is also probable, in the opinion of some high authorities, that—like birds—they had a rapid circulation of the blood and continuously high body temperature, and were far above the reptilian stage in this respect. Indeed the high type of brain and the active life of a flying animal could hardly be maintained save through a high type of circulation such as mammals and especially birds possess.

Pterodactyls Are Reptiles nevertheless

But why call them reptiles? Why are they not a featherless bird or a



SKELETON OF GIANT FLYING REPTILE, PTERANODON

As mounted on the fourth floor of the American Museum

This specimen was found in the Cretaceous chalk of western Kansas by Mr. H. T. Martin in 1916, and is sixteen feet from tip to tip of the wings as mounted. The bones are very thin and fragile, and it is thought that the animal did not weigh in life more than twenty-five pounds.

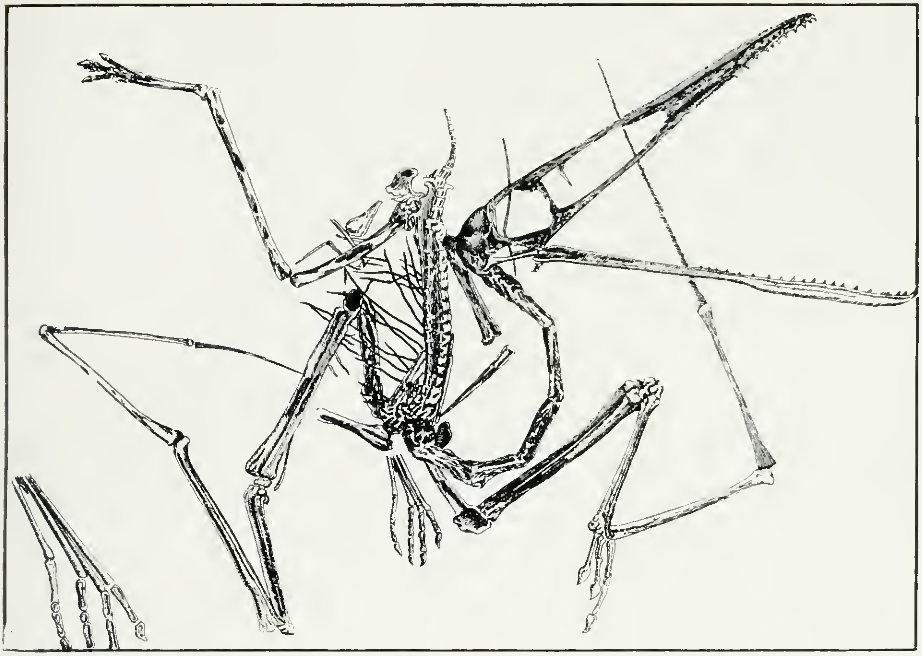
The missing parts are painted on the background, and the supposed outlines of the wings restored in a lighter tint. Most of the skull, part of one wing, and one of the hind legs were missing; the ribs were scattered and incomplete, but it was not practicable to re-set them or restore their missing parts hairless bat, since they must admittedly have been more like these higher types of animals than like the lowly reptile in the most important aspects of their life and habits? The answer to that turns really upon theories of relationship and evolution of the different races of animals—theories, however, that are so universally accepted and almost unconsciously used that they might better be called principles.

Deliberately or unconsciously we have always adjusted or allocated an individual or a race by its affinities, not by its occupation. A "flitter-mouse" (bat) is not a bird, however much like a bird it may look and however little like its terrestrial cousins. A seal or a porpoise is no longer a "fish" the moment you recognize its closer kinship to the terrestrial mammals, although it looks much like a fish and is very different from the four-legged beasts of the land. Classification is all a matter of kinship, of relationship, and always has been, no matter whether you declare your belief in "Darwinism" or oppose it as violently as you please.

So then with our pterodactyls. They are not birds nor bats, but flying reptiles, because, in spite of their resemblance in habits to the birds and bats, and of the resemblance in proportions and in many adaptive characters that this has brought about, they are not at all related to the birds, but are descended from one group of primitive reptiles, while the birds are (more remotely) descended from another group. They form, indeed, a group apart from all other reptiles, but not so far apart that we strain the facts if we call them flying reptiles. The proof of all this, the evidence of relationship, lies in the comparison of the bones in pterodactyls, in birds, and in the various kinds of reptiles, especially in such parts and points of construction as are least altered or obscured by the changes that have fitted each race to its particular habits of life. There are innumerable points of detail to be compared in this way. Here it is possible only to suggest a few of the broader points in the skeleton construction that bear on its relationship.

First as to the wings: they are modified fore limbs, as in other vertebrates. The wings of insects are different, arising from the back and having nothing to do with the limbs. But whenever a vertebrate forms a wing or flying membrane of any sort it supports it on its limbs. Mythical flying vertebrates—dragons, winged bulls and lions, fairies—and angels—would appear to form an exception to this rule: their wings also grow out of the back, like those of insects, independent of the limbs. In real vertebrates, however, such membranes are always stretched either by the fore and hind limbs or by the fore limbs alone. And in the three groups of vertebrates in which this flying membrane has become so far developed as to make them capable of genuine sustained flight, namely, the birds, the bats, and the pterodactyls, the fore limbs are extended and specialized to an extreme degree to carry the greatly extended wing. But the necessary result is attained in the three groups by three distinct methods.

(1) In the bird the fore-limb bones are greatly elongated, and, with the first three digits stretched out side by side and quite solidly united together, carry the long wing feathers which extend and outline the form of the wing itself. (2) In the bat there are no feathers, but a thin membrane which is stretched out umbrella-fashion on four long slender digits, the second, third, fourth and fifth. (3) In the pterodactyl, as in the bat, there is a thin smooth membrane, but it is stretched upon the fourth digit only, the first, second and third digits being reduced to small claws which lie on the upper border of the wing.



This specimen, the first discovered pterodactyl skeleton, was described by Collini in 1784 among the curios of the Elector Palatine at Mannheim, Germany. It was recognized by Cuvier as the remains of a flying reptile. It is quite a small animal. The gigantic *Pteranodon* was not discovered until 1870

This skeleton of the long-tailed pterodactyl, *Rhamphorhynchus*, shows the thin leathery wings of these flying reptiles. This rare specimen is one of the treasures of the Peabody Museum of Yale University. It was found in the lithographic limestone quarries of Bavaria. (*After Marsh*)

The bat, when at rest, hangs upside down by the claws of the hind feet. The pterodactyl apparently hung right side up by the claws of the fore feet. The bird, instead of hanging, perches upright on a branch or on the ground.

The bird and the pterodactyl both share the reptilian character of the articulation of the lower jaw with a separate quadrate bone, not directly with the solid skull. In the bat, as in all other mammals, the lower jaw articulates directly with the skull.

Bats, like all mammals, have three joints on each finger except the first—and this is true of the greatly elongated wing fingers as well as of the toes of the hind feet. Birds, like the group of reptiles to which they are related, have a regularly increasing number of joints in the hind-foot toes (2, 3, 4, 5) but the wing fingers are too much reduced to show this any more. In the pterodactyls, derived from a group of reptiles with the same "formula" of joints in the toes, the fore claw shows 2, 3, 4, and the great wing finger also 4, its claw being lost; so that it evidently is derived from a series 2, 3, 4, 5. No trace is left of the fifth digit, which should have 3 joints. In the hind foot the series is 2, 3, 4, 5, just as in primitive reptiles.

These are a few points outstanding from numerous details in the construction of the skeleton, whereby the pterodactyls can be compared with birds, with mammals, and with reptiles.

Early Discoveries of Pterodactyls

Pterodactyls have been known for more than a century. The earliest published notice of the fossil skeleton was in 1784, by Collini, who was curator of the private museum of curios belonging to the Elector Palatine. Collini had no notion, however, that the skeleton had belonged to a flying reptile; he observed that it was clearly not a bird nor a bat; it might perhaps, he thought, be some kind of amphibian, but he concluded that it was probably the skeleton of some marine animal. It was recognized by Cuvier in 1801 as being a flying reptile. Other learned scientists of the time insisted that it was a bat, or a bird, or a flying fish. Cuvier's description and discussion of the animal in his *Ossemens Fossiles* is a masterpiece of sound scientific argument which, although it did not convince all of his contemporaries, has settled the question for his successors. Many specimens, mostly of small kinds, were later described and figured by von Meyer, Wagner, Quenstedt, Plieninger, and other German naturalists, by Owen, Seeley, and others in England, and Winckler in Holland, and by Marsh, Williston, and Eaton in this country. The finest skeletons of these little pterodactyls have been secured from the lithographic limestone of Solenhofen and other places in Bavaria. The Munich Museum has a very fine series of these beautiful little fossils, and many more are scattered through various European museums. Only a few are in American museums. One beautiful little skeleton, perfectly preserved, but no larger than a sparrow, is in the American Museum's collections. It was obtained in exchange for a hind leg of the huge *Brontosaurus* sent to the Munich Museum,—one of the least of extinct reptiles in exchange for a part of one of the greatest. Some of the Solenhofen pterodactyls were of larger size, up to two or three feet spread of wings. Some had short tails; others, such as the *Rhamphorhynchus*, had long slender tails. A few beautiful specimens have been found in the Jurassic limestones of England—notably the *Dimorphodon* and *Ornithodesmus*.

Appearance and Habits of the Pterodactyls

It is chiefly these little pterodactyls of the Jurassic period, all of them comparatively small and primitive, that have been studied by scientists. Between them and the giant *Pteranodon* of the Cretaceous formations of America and England there is evidently a wide gap, partly filled by the smaller and more primitive *Nyctosaurus* that is also found in the Kansas chalk beds. The earlier pterodactyls look enough like reptiles to be unmistakable, and to afford many suggestions of their appearance in life. They must have been rather quaint little creatures, more bat than bird, but very different from bats in the little reptile head with projecting needle teeth, as also in the long slender wing and the soaring flight. The *Pteranodon,* on the other hand, and this is true too of *Nyctosaurus,* impresses us as having been converted into a great elaborate machine, rather unwieldy, one feels, on account of its great size, and as having lost all resemblance to a real or living animal. Perhaps it was not so, yet the intense specialization of every detail of its skeleton gives this mechanical impression very strongly. I cannot see in it anything beyond a marvelously elaborate mechanism, gigantic in size, perfected in every detail of adaptation to its singular mode of life, automatic and precise in its response to every gust of the changing wind, to every distant flicker of light or shade that might indicate some prospect of prey or warn of a lurking enemy. I can picture him soaring as the great sea birds do today, sweeping tirelessly across the broad glittering surface of the Cretaceous seas, patrolling them from dawn to dusk in search of such unwary fish or pelagic mollusks as might be sunning themselves at the surface and come within reach of the sudden swoop from above. Generally, I imagine, he would avoid actually coming down upon the surface of the water, for that would involve at least a great deal of difficulty in rising again into the air—indeed it is not easy to see how it would be possible for the giant *Pteranodon* to rise from the level sea, save through aid of the wind. At night he would perhaps return to the shore many miles distant, and hang himself up on some favored roost—tree or rocky point—anywhere that would be securely out of reach of the dinosaurs and other fierce reptilian beasts of prey which lived upon the land.

Whether the pterodactyls laid eggs, how these eggs were hatched and cared for, we have no means of knowing. Nor do we know much about their origin and evolution. They appear, full-fledged, in the Jurassic slate and limestone formations of England and Germany; of their early evolutionary stages nothing, or next to nothing, has yet been discovered. Another gap, as we have already indicated, separates these Jurassic pterodactyls from the huge aviating machines that are found in the deep-sea formations of the late Cretaceous. Perhaps these really were the last survivors; perhaps they are but one type of a varied world of flying reptiles whose forms and habitat the rocks have not yet revealed to us. When we reflect on how many discoveries in the terrestrial life of the Cretaceous period have been made during the last quarter century, it may well seem that there is much to be discovered about pterodactyls by diligent and systematic search in the formations of the Age of Reptiles.

European Pterodactyls are Mostly from Stone Quarries

Most of the discoveries in Europe have been incidental to the working of the great quarries of lithographic limestone in Germany; a few have been made in the quarries for roofing and finishing slate at Holzmaden. In England the greensand quarries, worked for fertilizer material, have been the most important source of pterodactyl bones. From these sources there is not much to be expected in the future. Lithography is almost a vanished art nowadays, so far has it been superseded by photographic methods of reproducing illustrations. Slate quarries are still worked, but more and more the natural slates tend to be replaced by cement and other artificial substitutes. Greensands as a source of potash have been largely superseded by the German and Alsatian potash salts and other sources. Perhaps the greensand quarries, both in Europe and in this country, may again be extensively worked if some practical process is devised for extracting their potash in a soluble and concentrated form, and thereby reducing the cost of transportation. But any future excavating would be done with steam shovels, and the chance of saving delicate fossil bones would be very slight.

Prospects for Future Discoveries

For these reasons future discoveries of pterodactyls will probably come only as the result of direct and systematic search for these and other fossil specimens. We can no longer hope for them as a by-product of other quarrying operations. How many such quarries will pay to work for the fossils alone we do not know. Some probably will, others will not; an individual study of each will be needed. There is no doubt that the American Cretaceous formations will continue in the future as in the past to yield specimens of the giant *Pteranodon* and its relatives. It may well be also that systematic search would reveal important new sources for specimens of the flying lizards.

Researches Needed in the Mechanics of Pterodactyl Flight

It is also certain that much more could be learned by systematic and thorough study of all the pterodactyl specimens that have been found and are preserved in various museums. Such studies would be most profitable from the point of view of the mechanics of their flight. Researches in aviation during the last few years would throw a great deal of light, heretofore unavailable, on the mechanics of pterodactyl flight. And it is highly probable that this study in turn would aid in some unexpected ways in our practical knowledge of aviation, for the pterodactyl as a flying machine comes distinctly nearer in type to the aëroplane than do either birds or bats. Aëronautic societies or government departments might well find that a grant for research in the mechanics of flight of pterodactyls would be very profitable if wisely expended. And it is but right to say that it would be very easy to expend a good deal of money in such a research, if unwisely directed, without securing any commensurate results of either scientific or economic value. I believe that I could plan the expenditure of from $4000 to $5000 a year for from five to ten years, with a reasonable certainty of obtaining some results worth while, and an excellent prospect of getting data worth many times the expenditure. The success of such a research turns upon the selection of the right men to do the work in field and in laboratory; and I think I know who they are. It is hardly necessary to say that the American Museum would gladly aid in such work so far as practicable.

GIANT FLYING REPTILE

Restoration drawn under the supervision of the late Dr. S. P. Langley, of the Smithsonian Institution. It is supposed that the little white birds which look like gulls are *Ichthyornis*, one of the toothed birds of the Cretaceous period

Wood Turned to Opal

Reflecting colors of the rainbow, with a deep glow of red and orange, as if portraying the ancient volcanic fires which perhaps caused the change

By HERBERT P. WHITLOCK

Department of Mineralogy, American Museum of Natural History

IN Humboldt County, Nevada, in the heart of the great natural wonderland of the West, there have been brought to light quite recently some wonderful fossil remains of trees. These are remarkable not merely because they represent trees which have been turned to stone, but because the mineral that has taken the place of the once soft and porous vegetable tissue is the much sought after opal, which has of late years taken a high place among the popular gems.

To reconstruct the process by which this apparent miracle of nature has come about we must go back many thousand years. We must go back to the time when these trees clothed the mountain-sides or shaded the valleys roamed over by the mastodon and the saber-toothed tiger, a landscape far different from that which we see today from the car window or the pack horse trail. We must conceive this area, which we call Nevada, overwhelmed by some widespread disaster, possibly one of the earthquakes which must have been frequent in such a volcanic region. This reduced the growing forest to a swamp and buried the tree trunks under many feet of water-soaked débris.

It was then, when the trees had become mere water-logged snags, that the work of converting them into opal began. For the water which penetrated to their inmost pores was not the innocent fluid we are accustomed to dip from a wayside pond, but a more or less heavily charged solution of silica, probably heated by volcanic action.

Such a mineral water, gradually, as the wood of the tree yielded to decay, replaced this woody substance, particle for particle, with hydrated silica, often preserving with wonderful fidelity the cellular structure of the wood. Much of the opal which has thus replaced the substance of the wood is of the variety called semiopal, but some of the colloidal silica has been deposited as precious opal, and exhibits all of the beautiful and changing colors of that gem.

A fine and highly representative series of these Nevada wood opal replacements has been put on exhibition in the Morgan hall of minerals at the American Museum of Natural History. In this exhibition all the steps in the process of the remarkable change from wood to opal may be seen. To anyone unfamiliar with the variety of color exhibited by precious opal, the exhibition comes as a positive revelation.

Here one may see clear, glasslike fragments of former trees, which send back to the eye a rich ultramarine shade, like a veritable pool of light. Other pieces flash with brilliant red, orange, blue, and green, shifting and changing with every alteration in the position of the observer. Broad sheets of color and harlequin-like shadings stand in contrast with each other. A particularly unique specimen is of a dark, smoky general color which, when the light is caught at the right angle, reflects a dull glow of red and orange, almost as if portraying some of the fires of the extinct volcanoes which, no doubt, gave birth to its remarkable metamorphosis.

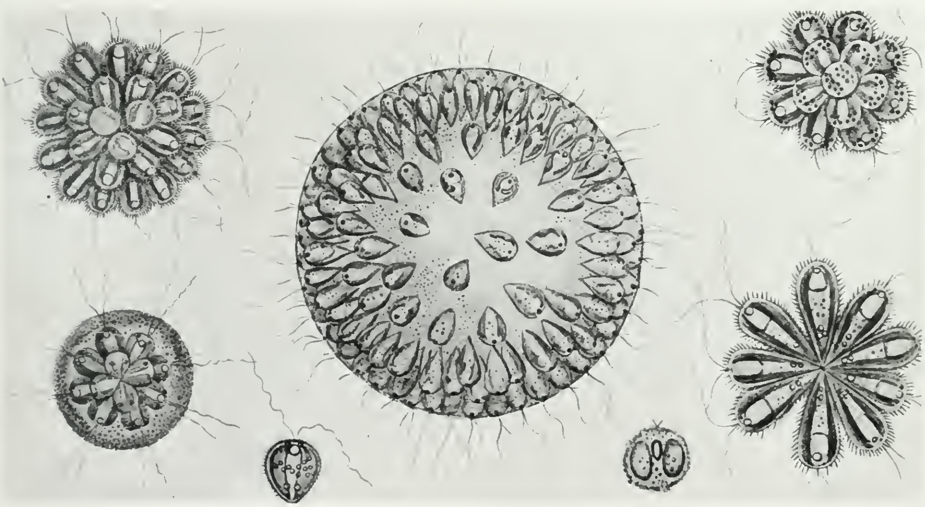
Microscopical Trouble-makers in the Water Supply

By MORTON CHARLES KAHN
Department of Hygiene, Cornell University Medical College

WE have all, at one time or another, encountered foreign flavors and odors in the water supply, both agreeable and repugnant. For the most part these are due to the presence and growth of microscopical plants and animals. Such effects, together with the presence of turbidity and color, are always looked upon with suspicion by the public, for there is nothing to which a community is more sensitive than something unusual in its drinking water or in its household supply, be it detectable by smell, sight, or taste.

Large and small flowering plants, commonly found in reservoirs and along sources of water supply, such as pickerel weed (*Pontederia*), water plantain (*Alisma*), eelgrass (*Vallisneria*), and many others, rarely cause trouble. While they may be a nuisance in a mechanical way, due to their abundance, or even by contamination since they furnish a place of rest for the more obnoxious forms, still in themselves they are harmless, and produce no direct effect upon water used for domestic purposes. It may be said that although a large accumulation of these plants undergoing the processes of decay, together with other decomposing organic matter, may produce unpleasant flavors and odors, this condition seldom occurs and if it does it is a comparatively easy task to rid a water supply of this trouble.

There remains one group of plants, the algæ, mainly microscopic, which is unfamiliar to most people and much too often neglected because it seems to possess no economic importance. This is a mistake, for these microscopical

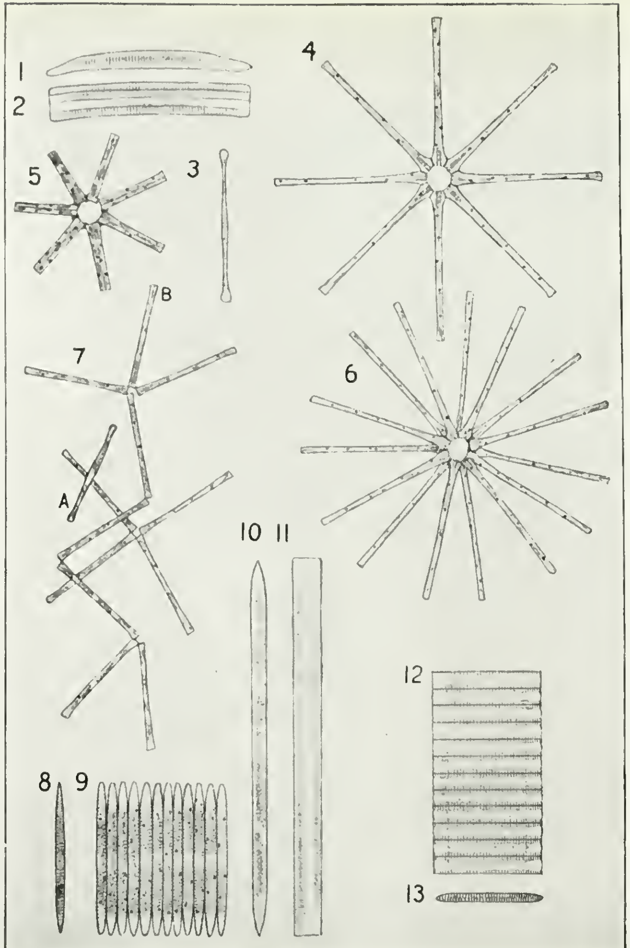


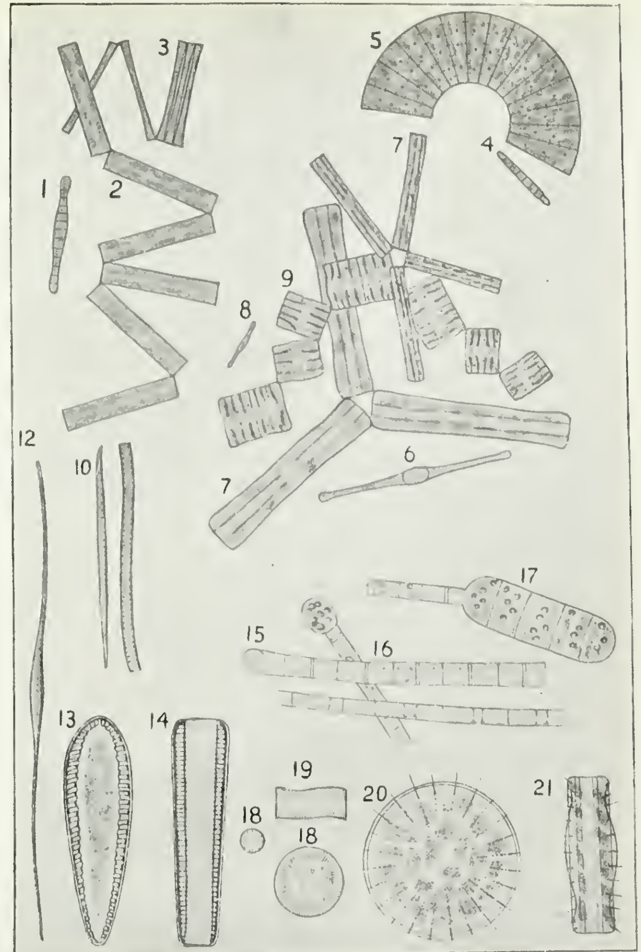
The most important contaminators of any public water supply are not weeds or large animals but one-celled plants and animalcules and pathogenic bacteria. The peculiar oil found in *Uroglena* (center in illustration) and liberated when this microörganism is ruptured, is a source of the disagreeable fishy and oily odor sometimes characterizing a public water supply. The *Uroglena* (claimed alike by botanists and zoölogists) grow in colonies, single-celled bodies embedded in the surface of a gelatinous sphere. Only the slightest pressure is required to break the delicate structure—even the pressure of water in a stand pipe or the disturbance caused by pumping. The other forms in the illustration are *Synura* and *Syncrypta*. Bad odors, especially cucumber odors, have in the past been traced to *Synura*, both in the Boston supply and in the Croton supply of New York. Even so few as five or ten colonies to a cubic centimeter will cause a perceptible odor. Strangely enough these forms are sometimes most numerous in winter just underneath the ice

DIATOMS IN THE WATER SUPPLY

The microscopic diatoms may cause disagreeable odors in drinking water. A diatom is very beautiful seen under a microscope, geometrical in design, with two transparent valves, fitting one into the other like a shallow glass box and its cover. The valves are variously marked with points or grooves so minute that from several hundred to several thousand occupy a millimeter. These increase the friction of the diatom with the water and tend to prevent it from sinking—for a diatom is heavier than water, yet must float near enough to the surface to get sunlight for growth. The silica in the valves has commercial value: deposits of many generations of diatoms form "diatomaceous earth" which reaches the market in various polishing powders, including tooth powder; also as an absorbent for nitroglycerin in the manufacture of dynamite. The illustrations show common diatoms in both valve and face views; 3 and 4 (at the left) are *Asterionella* which may give a fishy odor to water; 6 illustrates the rapid multiplication of *Asterionella* by division.

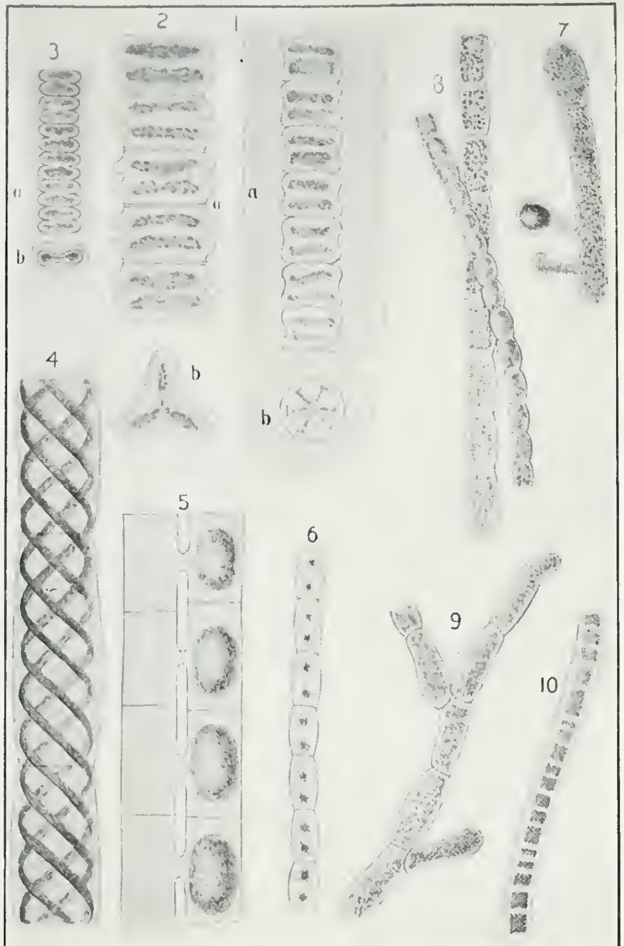
Diatoms may also prove troublesome in water used for laundering or for paper making because of their greenish yellow pigment, similar to the chlorophyll of green plants.

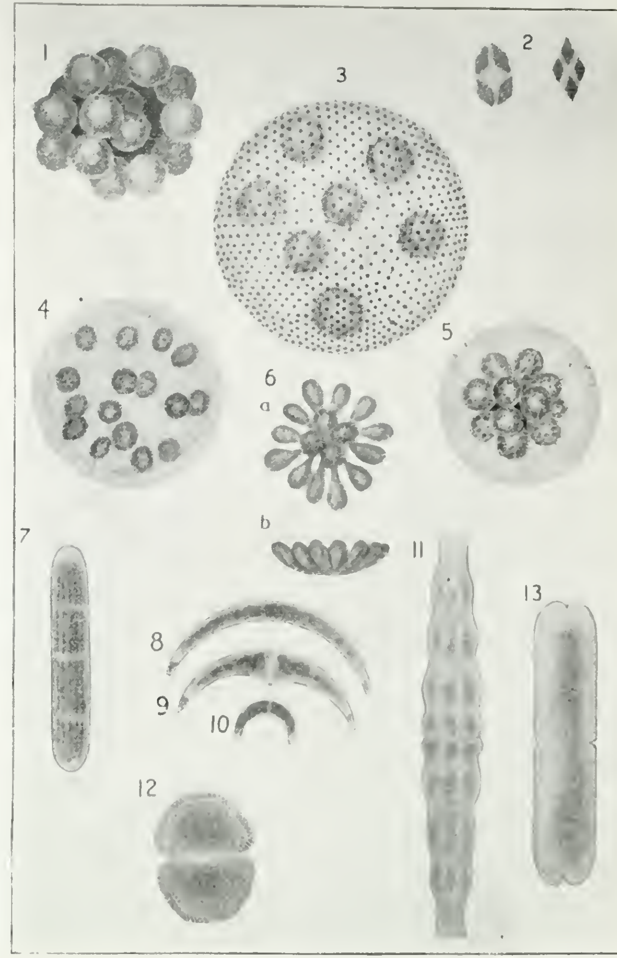




Myriads of diatoms swarm in the plankton of both fresh-water ponds and of the sea where they supply an important diet for fish. It is said there are nearly 10,000 species. Various species may appear in a pond in succession during the year, and different species in different years. Some species have a spring and fall period of maximum growth, such are *Synedra* (8–11), and in the illustration at the right *Diatoma* (1–3) and *Tabellaria* (6–9). In general, diatoms do not require a high temperature for growth. Some species are actively motile, probably as a mechanical result from the liberation of oxygen during photosynthesis. A water supply containing diatoms or other minute plant forms must be purified by aëration and filtration in the reservoir

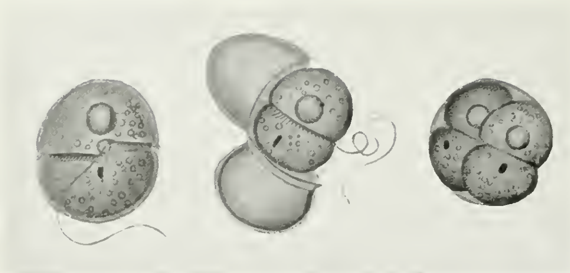
MINUTE WATER PLANTS



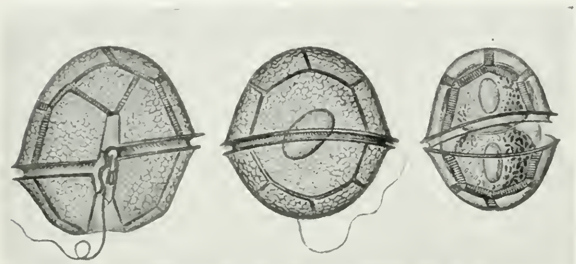


The common bright green scum of our ponds is frequently formed of masses of the long, many-celled *Spirogyra* filaments, with their beautiful spiral fronds. This plant is shown in 4, at the left, also in 5 after the formation of zygospores, each made by union of the cell contents of adjoining filaments. Not the least of the damage occasioned by this plant is that it causes the larger water plants to decay by forming a scum so dense that they are choked out. Water cress grown for market in winter beds may sometimes be destroyed in this way. Other filamentous algæ of great beauty and interest for the botanist, but which have natural odors and may be sources of disturbance in reservoirs of water supply, are (at the left) *Hyalotheca* (1), *Zygnema* (6), *Vaucheria* (7), *Conferva* (8), *Cladophora* (9).

A form such as *Volvox* (at the right, 3), is especially adapted for floating at the surface of the reservoir. It consists of a gelatinous sphere often one millimeter in diameter in which the several thousand microscopical cells (black dots in the drawing) are embedded, with their cilia pointing outward. By the beat of this multitude of cilia the sphere, which is lighter than water, is kept rotating and moving about independently like an animal. This form contributes a strong fishy odor and must be filtrated from the water supply. It reproduces rapidly through development of daughter colonies by division of cells (the darker inner spheres) Such forms as *Eudorina* (4) and *Pandorina* (5) also may give a fishy odor to the water



It is said that *Glenodinium* imparts a fishy odor to water in which it grows, but the species is not common enough to be an important source of trouble. In gelatinous masses on the water it shows phosphorescence



Peridinium is a consort of the diatoms in the floating life of lakes and reservoirs and especially of the sea. It is not sufficiently abundant to be troublesome in the water supply, but it is said that it produces a fishy odor "like that of clam shells." Both this and *Glenodinium* are enclosed in shells of cellulose, and contain chlorophyll and starch granules and so are frequently classed with plants

plants have a real influence on the general public welfare, in that they are direct causative agents for practically all of the bad odors and flavors in drinking water and, besides the bacteria and a few protozoans, are the only organisms which need be taken into account when considering the biology of drinking water from a hygienic standpoint. Some of the algæ may be seen with the naked eye, that is of course when they occur in vast numbers so as to form a scum on the water's surface. Most of them may be seen only with a microscope, and it is only by the aid of this powerful magnifying instrument that any of their individual structures can be studied. Their structure too, for the most part, is very beautiful, forming one of the most fascinating fields of microscopy.

Let us first consider the diatoms, a great group of trouble-makers belonging to the algæ. It is known that some of them give rise to serious trouble in the water supply.

Water inhabited by excessive numbers of these organisms most frequently develops a very disagreeable fishy odor. Some people think the odor like that of geraniums. Personally, however, I think it far less agreeable than the fragrance of this common garden flower. The specific types of diatoms which cause the disagreeable conditions are: *Asterionella,* responsible for the distinct fishy smell, and *Tabellaria, Meridion,* and *Diatoma,* when they become numerous. When sparse, on the other hand, they are possessed of a distinct aromatic principle, which is not considered disagreeable. Diatoms are exceedingly troublesome when contained in water used for laundry purposes, or for the manufacture of paper. This is due to the fact that they contain a greenish pigment, which stains articles coming in contact with it.

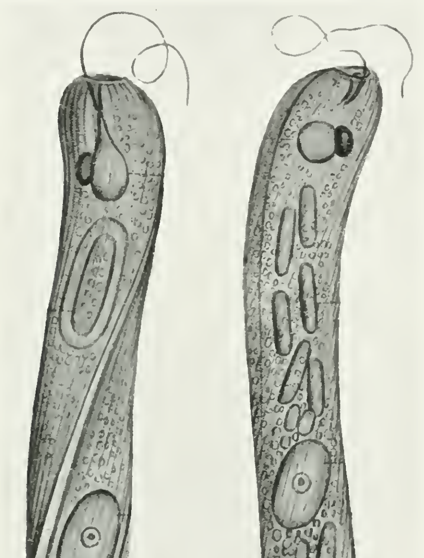
Structurally a diatom is very beautiful. It may be described as resembling a glass box made up of two halves, one fitting tightly within the other, the walls being strongly silicified. Diatoms are not without their redeeming features, for it is this silica contained in diatomaceous earth that makes it valuable as a polishing powder. Earth containing diatomous remnants is used to some extent in the manufacture of dynamite. Diatom shells form no mean portion of certain of our well-known brands of tooth powder, and last but by no means least, the living marine types form an important part of the diet of some of our food fishes.

The methods used for multiplication by these members of the Diatomaceæ, are unlike anything of a similar nature found elsewhere among the algæ. The two valves or halves of the organism begin a slight process of separation, and as the contents divides into two parts, there are formed within, two new halves, one fitting into the larger half of the original cell, and the other forming a new box within the smaller half of the parent cell. These then separate, forming exact counterparts of the mother cell, although one is a trifle smaller than the other. In addition to the above mentioned method of reproduction, the plant also possesses the power to form a large spore, making it more or less resistant to adverse conditions; also, it has been noted that the diatom cell may break up into a number of much smaller spores, each one capable of developing into a new plant.

One organism claimed alike by botanist and zoölogist, but at any rate a trouble-maker for the hygienist, is *Uroglena,* belonging to a group known botanically as Syngeneticeæ. This form demands especial attention, for it is probably responsible for more trouble in the water supply than any single representative of the various groups of microscopical plants, excluding of course the pathogenic bacteria.

Uroglena is widely distributed over the United States, but is more frequently encountered in New England and in some of our middle western states, Indiana, Ohio, and others. *Uroglena* lives in colonies in appearance resembling a colorless sphere, with a large number of greenish cells embedded in the periphery. Usually much smaller than one half a millimeter in diameter, the *Uroglena* colony may however attain that size. Each individual cell is equipped with a pair of cilia of unequal length, and it is by vibration of these hairlike appendages that the colony is propelled through the water. Each cell of the colony contains in addition to a well-defined nucleus, which appears as a red spot, a single greenish colored body, and several vacuoles. By far the most important content of the cell from a sanitary standpoint and the one that causes the organism to be feared by those responsible for the water supply, is the large number of oil globules. It is the liberation of this oil that causes all of the trouble, namely the detested fish-oily odor usually attributed to water containing this form of life. The oil seems to be held in rather loose combination, so that the mechanical breaking of the colony serves to liberate it in sufficient quantity grossly to contaminate the water. The cells of *Uroglena* are, unfortunately, very fragile, and much force is not required to rupture them and liberate the oil. Usually mere pumping, or even the force of gravity through pipe lines necessary to distribute the water, is enough to cause the disturbance. The exact nature of the oil is not very well understood. It is believed that it is not unlike the so-called essential oils, being nonvolatile at the temperature of boiling water, and seeming to resemble the oils obtained from some of the diatoms and blue-green algæ.

The methods of cell division in *Uroglena* are somewhat peculiar and decidedly interesting. Before dividing, the cell seems to turn in the periphery of the hollow gelatinous sphere, until it is at right angles to the position usually occupied. Then at the end of the cell which originally pointed toward the center of the sphere, there is formed a pair of cilia similar to those at the opposite pole, and the appearance of the characteristic spots of red is then noticed. The cell begins to be sharply constricted, and as it gradually divides, the two halves are drawn back through an angle of about 45°, so that when the cells are finally formed, they occupy a position similar to the one normally assumed by the parent. When a cell colony becomes too large, it divides into individual cells, and these by numerous processes of division soon grow into new spheres. In addition *Uroglena* is also able to form spores, so that it is quite ready to survive periods that would normally lead to its extermination or at any rate seriously handicap its multiplication. Queerly enough, *Uroglena* seems to thrive best during the cold winter months, especially when the surface of the water is frozen. In Europe just the reverse is true, July and August are the months most favorable to its growth, and it disappears altogether at the approach of cold weather. For this reason many seem to think that the European and American types are different species.



Among the microörganisms found on the surface of pools are several claimed by both botanists and zoölogists. Such is *Euglena*, a minute free-swimming organism with a flexible whiplike flagellum near the mouth. Immense numbers of *Euglena* may collect in a green or reddish scum on the quiet water of ponds or reservoirs

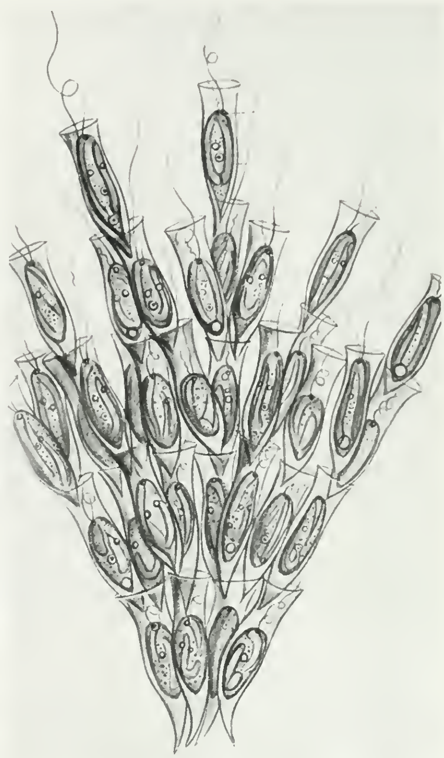
Other Syngeneticeæ are concerned with the contamination of water, but usually not to the same extent. *Synura* and *Syncrypta* are both accused of having a bad effect, *Synura* being responsible for the offensive "ripe cucumber" odor formerly thought to be caused by fresh-water sponges.

Without doubt *Uvella* should be spoken of, as it is one of our most dreaded forms, and to it has been reputed the cause of an acid taste in the water which is most disagreeable. It greatly resembles *Synura* and many believe it to be the same organism; it differs, however, from that form in the lack of a separate investing membrane, and by the posterior location of the contractile vacuole. There are also few zoöids contained in the cluster.

Another very bothersome water microörganism, which may be the cause of much annoyance, is the common *Spirogyra*, which has been known to cause thousands of dollars' worth of damage by smothering growing water cress in artificial beds constructed for the winter propagation of this salad plant. When the cress is cut for market, the mutilation leaves the plant in a much weakened condition, and if *Spirogyra* gets a start, it forms a thick mat over the surface of the water, preventing the growth of the cress, and often killing the entire crop in a given district.

Anabæna, one of our most important water contaminants belonging to the order Nematogenæ, surely merits more than a passing mention. George Chandler Whipple, professor of sanitary engineering in Harvard University, in a graphic description of the serious amount of trouble this form may cause, tells how the large Chestnut Hill Reservoir, Boston, was contaminated by *Anabœna.* This blue-green algal form multiplied to such an extent that in the course of a comparatively short time it polluted the entire line of supply of the communities getting their water from the above-mentioned source. In structure and form *Anabœna* much resembles an irregular chain of green beads. The vegetative cells are from five to twelve microns in diameter, depending on the species. It possesses both spores and peculiar dead cells called heterocysts. Being one of the most abundant producers of obnoxious oils, it causes annoyance in much the same way as does *Uroglena.*

Among other forms giving rise to unpleasant odors and flavors are *Dinobryon, Bursaria, Peridinium,* and *Glenodinium.* They are not often causes of bother, and are interesting for the most part because of their unusual structure, and like many other microörganisms show the varied forms of plant and animal life which may exist in a given source of water used for domestic purposes.



Some of the protozoans as *Dinobryon* collect to form simple colonies which may be either attached to objects in the water or free-swimming. New colonies are formed and dispersed by spores so that large numbers of the animalcules may be generated within a brief period if conditions are favorable. *Dinobryon* is classified as giving to water a fishy odor, "like rockweed." All odors given off from decomposing microscopic organisms are offensive, especially so when they contain a high percentage of nitrogen

Stentor never exists in sufficient numbers to become a pest and is for the most part negligible from the hygienic point of view. Rapidly vibrating cilia at the top where the mouth is, maintain a current which carries in food particles. *Stentor* may either attach itself to some foothold or remain free-swimming

To Dr. G. T. Moore, head of the Department of Botany, Marine Biological Laboratory, Woods Hole, and Mr. K. F. Kellerman, associate chief of the Bureau of Plant Industry, Washington, D. C., two of our most efficient experts on water biology, belongs the credit for suggesting a very good means of controlling these minute pests. The method consists of using small amounts of copper sulphate, a chemical which seems to have a specific toxicity for the lower forms of life. The requisite amount of copper sulphate is placed in a sack of coarse cloth, and drawn slowly back and forth over the surface of the water in the reservoir. Diffusion and the natural circulation of the water serve to mix the chemical and distribute it to all parts necessary. According to Professor Whipple the amount of copper sulphate to be used varies with the following factors: 1, organisms present; 2, temperature of the water; 3, the amount of dissolved organic matter; 4, hardness of the water. In the case of the more susceptible organisms such as *Uroglena* and *Anabæna,* dilutions of one part copper sulphate to five to twenty million parts of water is sufficient, while for the more resistant forms such as the diatoms, the amount required to produce a lethal effect on the species may be as great as one part of the chemical to one million parts of water. Fortunately, the organisms giving the greatest trouble are the ones which most easily succumb to the copper sulphate method of treatment.

Objections have been raised against this method, due to the poisonous nature of the substance used as an algæcide. There is little reason to believe that there is much to be feared, however, considering the high dilution of the chemical when it ultimately reaches the consumer, especially when the use of copper sulphate is followed by filtration of the water, for by filtering, the copper salt is largely removed. Much of the chemical is bound by the ever-present vegetation, while still another portion is precipitated. The use of the copper sulphate method of treatment is not advised, however, without expert supervision.

Pathogenic bacteria do not make the water unpalatable and thus are often tolerated in a water supply for a long time; not until there has been an alarming increase in the death rate from water-borne infections, is their injurious presence brought home forcibly to the general public. With algæ it is different, their presence for only a day or two will cause the water to become offensive to such an extent as to make the general rate of water consumption in the community fall far short of the amount needed for physical well-being. Even when a water supply is palatable in every way, people tend to drink far less than is normally needed. Just stop and consider what a vital substance water is: "Seventy per cent of our body weight is composed of it; it enters into the chemical composition of all of the tissues; it forms the chief ingredient of all fluids of the body and maintains their proper degree of dilution, and thus favors metabolism; by moistening various surfaces of the body, such as mucous and serous membranes, it prevents friction; it furnishes in the blood and lymph a fluid medium by which food may be taken to remote parts of the body and waste material removed, thus promoting rapid tissue changes; it serves as a distributor of body heat; and it regulates the body temperature by the physical process of absorption and evaporation."

One of the most common dietetic faults is neglect to take enough water into the system. It is important, then, to have a pure and wholesome water supply that may be partaken of with enjoyment by all.

Courtesy of the New York Times

A river of mountain water, at least 250 million gallons daily, is carried from the Catskills to the people of New York City, 100 miles to the southward, by means of one of the most splendid pieces of engineering work the world has ever known. Before starting on its long aqueduct journey the water passes through the great fountains of the Ashokan aëration plant.

It is the pleasure of NATURAL HISTORY to announce publication in an early issue of an article by Dr. Charles P. Berkey, of Columbia University, on the Catskill water supply of New York City. Dr. Berkey was geologist during the ten years of preparation and of active operations at Ashokan and elsewhere on the new system

The Fountains of Ashokan [1]

By ROBERT UNDERWOOD JOHNSON

Henceforth what dream can e'er efface
  Ashokan's pure and irised throng?
Not Dryads, nor the Dryads' grace,
  Not Naiads, nor the Naiads' song.

Like ghosts of cedars, cool and tall—
  They mount close-clustered row on row—
As white as when the moonbeams fall
  Upon the newly fallen snow.

Yet they are not a thing of night,
  But souls of nymphs that stand by day
Poised for a fellowship of flight
  While with their robes the breezes play.

They live in light—not spirits dire
  That haunt the darkness—not to harm,
But like a massed angelic choir
  With songs of benison and charm.

For not of Death their waters speak
  But Life, these glad Ashokan towers:
In heavenly ministry they seek
  The city's human weeds and flowers.

Ah, could they flash their song and sight
  To house and hovel as they pass,
How urban toil and care and blight
  Would quaff new beauty with the glass!

[1] By permission of the Author and of Yale University Press.

For the Sake of His Ancestors

By MALCOLM P. ANDERSON

FOREWORD.—Mr. Malcolm P. Anderson, who lost his life in patriotic service in a California shipyard in the third year of the war, was an explorer and field collector who had a future of unusual promise. Previous to 1904 when he received his degree from Leland Stanford Junior University, he had tramped thousands of miles while studying the fauna and flora of California and Arizona, and had accompanied an expedition to Alaska. From 1904 to 1908 he acted as leader, chosen by the London Zoölogical Society, of the Duke of Bedford's Expedition to Eastern Asia, under the immediate direction of Mr. Oldfield Thomas, mammalogist. In 1909–10 he returned to the work, traveling much in China, in the desert to the north beyond the Great Wall, and in the mountains on the border of Thibet. Later he went on two expeditions to South America. The following is an extract from a letter to the Editor, written by his father, Melville B. Anderson, professor emeritus of English literature at Leland Stanford Junior University, to accompany the manuscript of the Chinese story:

"This story of Chinese life by my son, Malcolm P. Anderson, is hardly of a nature to appeal to the jaded taste of readers of our garish story magazines. It is a plain tale plainly told by one who was far more expert with the implements of the field collector than with the pen. If I venture to offer it to you for publication, I do so because I deem it of distinct value for minute fidelity to the facts, the tone, the color, the feeling of the human scene, which is set in a mountainous region of one of the remote provinces of China. With such scenes my son became familiar during long, lonely months and years spent in the wilder parts of that empire while engaged, as head of the Duke of Bedford's Expedition to Eastern Asia, in making those collections which Mr. Oldfield Thomas has praised as among the best of their kind

"Doubtless I am no impartial judge, but perhaps you will permit me to say that I find great charm in the somewhat archaic simplicity of the style of this tale—a simplicity which those who knew the author will recognize and esteem as of the essence of the man himself. Let me add that he was not unaware of a certain scanty sufficiency in the evidence offered at the trial for the conviction of the robber and false accuser; and that he had planned an important change in the plot, involving a re-writing of the latter part of the tale. But I cannot bring myself to tamper with what is written. I feel that changes made by another hand would introduce a jarring note. As the little, unpretending narrative stands, there is scarcely a sentence which is not suffused with Chinese atmosphere; at all events these beings breathe an air that is different from ours; yet different as is their moral atmosphere, the tale helps us to realize that they are human equally with ourselves. Therefore it does attain one of the great purposes of art."

I

IT had been market day in Ling-tai-miao, and Lao Fung, the village storekeeper, had made a number of good sales of cloth shoes, rice, and dried persimmons. Now when the winter evening had come, and the shutters were up before the shop, he sat by his table counting his gain.

The little old Chinaman was wrapped in a heavily quilted blue gown, the long sleeves of which were rolled back to give him the use of his hands. At his feet burned a charcoal brazier, and on the table stood a rush lamp casting a feeble light on the dusty shelves of merchandise, the piles of brass cash on the table, and on the wrinkled face of Fung.

Deftly and quickly the practiced teller arranged the coins in a tier in his left hand, and counted them by fives as he passed them to his right. His task was almost finished when a voice addressed him through the shutters, which alone separated the shop from the street.

"Lao Fung, admit your most humble servant, who has come far to speak with you."

The old man was startled, but replied at once, "Who is the gracious speaker?"

"I am Han of the mountain-side," came the answer. "I come to settle my debt with you before the close of the year."

Fung quietly drew out his strong box and laid the cash away. Then he went out of the room into the courtyard, where he opened the small door in the bottom of the great gate which formed the main entrance to his house. There entered, bowing, a tall young peasant followed by a little girl of no more than six years. The man was hatless, and dressed in a faded blue gown. The child wore a dingy, red-flowered jacket, and pantalettes of green that came to her ankles. On her head she had a hood of red.

The master of the household, with profuse apologies for his dilapidated establishment, led them into his place of business. A long conversation followed, during which Fung eyed the child closely, and appeared to be making up his mind about something. Finally Han came to the real object of his visit.

"Honorable Fung," he said, "my farm has yielded me next to nothing from the last harvest, and I am not able to pay my debt to you in silver, as I agreed to do. During the great rains the mountain sent down a landslide which destroyed much of my land beyond redemption. The burial of my father has taken every ounce of silver I have been able to save for years, and now that the time of settlement has come, I have nothing to offer you but the services of this child, my daughter Ma-wu. She is dutiful, and will be faithful till I am able to purchase her liberty."

Fung looked at the child again. She was a quick, bright-eyed little person, and seemed to understand what was taking place, yet she showed no fear.

"Is the child strong and in good health?" asked Fung. "What work can she do?"

"She can carry crops from the fields, and fuel of twigs and grass from the hillsides. She can clean the pots in the kitchen. She always does as she is bidden."

"Very well," said Fung, "I will take the child on probation, and if after a month I find her satisfactory, I will cancel your debt."

Thus Han sold his youngest child into slavery, but Han was not a bad man. He simply followed the custom of the Chinese peasantry when hard pressed by debts. Had not his own sister been enslaved in much the same way?

Weeks later, Lu, the wife of Fung, sat by her gateway with some of the village gossips. Although it was still winter, the afternoon sun had been bright and pleasant, and these women had taken advantage of it to warm themselves and breathe the fresh air.

"There comes your new servant child," said one woman to Lu, looking down the village street. Ma-wu was to be seen coming slowly along with a rake in her arms and a large basket of twigs and pine needles on her back.

"Yes, but see how slowly the lazy child moves," responded Lu. "She has been out since noon, and has gathered no more than fuel enough for tonight. I wish Han would take her back and pay his debts in silver."

"Look at the clumsy child!"

Ma-wu had stumbled on the rough pavement, and overbalanced by her large burden, had fallen, scattering part of the fuel in the street. For a moment the child lay struggling to be free of the heavy basket; then she was helped to her feet by a traveler, who came up accompanied by a tall boy. The lad hurried about, gathering up the scattered twigs and replacing them in the basket. When this was done he said in a cheering voice:

"I used to gather fuel until I got large enough to help Father at his trade. It was hard work, too, for in our country we don't have the trees and bushes and tall grass you have here in the mountains. Where do you live, little Lotus Flower?"

Ma-wu pointed to the door where the woman sat, and turned to enter as he asked the question. She was too young to know how to answer the boy or thank him, but she felt gratitude, and was happier because these people had been kind to her.

As the travelers went up the street, Shan-liang, the innkeeper, stood in his doorway. The father and the son noticed the inn, paused, then entered, and asked for accommodation for the night.

The host was a kindly old man, who, without being avaricious, had gathered enough wealth to place him second to Lao Fung in the estimation of the villagers. Personally he was far more popular than Fung, for the latter was a hard taskmaster and had a reputation for bad temper.

Shan-liang welcomed his guests as they entered. It was polite to show interest in their affairs, so he asked them questions.

"Honored guests, where have you come from?"

"Today we have tramped from Fen-shien. We have been twenty days in coming from the province of Honan, where is the home of our ancestors."

"And why do you and your son travel?" asked Shan-liang. "You carry no merchandise."

"No, we are seeking a new place to settle. I am a smith, and my son is my assistant."

"Then here is the very place for you," exclaimed the old man. "Our poor village is small, and could give you but little custom, but this road is a highway across the mountains, and is traveled by many mule trains and retinues of officials. Often strangers ask to have their mules shod, and I have to send them away unsatisfied. Now what is your honorable name?" he concluded.

"My base name is Shu, and my son's name is Gan," answered the traveler.

The lad had been looking up at the mountains that rose on east and west. Now he spoke for the first time:

"What mountains you have here, and what forests! On those heights there must be great trees and wild animals."

"Yes," replied the innkeeper, "there are wild animals nearer than that. The boars and deer eat our crops on the hillside yonder.

"Father," said the boy, "with the forest near it will be easy to get charcoal for our forge. We can even go on the mountain and make it ourselves."

"That is true, and since you like this place so well, we will look about the village tomorrow, and perhaps build our shop here."

So Shu and his son became residents of Ling-tai-miao. They built their shop of sun-baked bricks, selecting a spot at the upper end of the village, a rocky place between the mountain and the river that none other had cared to claim.

II

Gan and his assistant, Pang-tze, swept up their smithy after a busy day, and as they finished, these two active young men laid plans for the morning.

"Take down the guns, Pang-tze, and make them ready," said the smith. "There will be no shoeing of mules till next market day, so we may as well go on a hunt."

"I'm out of powder and slugs," said the tall Pang-tze, "but perhaps we can get some saltpeter from old Fung. What shall we hunt, the deer or the boar?"

"Anything we come across," replied his master. "I have sulphur and charcoal. You get some saltpeter, and we will make powder in plenty."

They spent the evening in preparation, cutting some slugs from a bar of iron, cleaning up their matchlock guns, loading them, and covering the lock of each with the skin of a badger, to keep out the snow.

Early morning found them tramping up the steep mountain toward the forest, their guns slung on their backs, and their sandaled feet shod with iron spikes to help them cling to the icy trail.

All day they climbed upward through the forest, but no game crossed their path. Near nightfall they made their way to the foot of an overhanging cliff, which gave them shelter. There they lighted a fire and toasted their crude corn cake in the ashes. They slept as they sat, for within their cavern there was no room to lie down.

Daylight found them ready to start again, and both hopefully for the day's hunt. Together they climbed to the high ridge above their camp, and there in the snow they found the tracks of a herd of great wild goats.

Stopping in a pass they laid their guns down side by side and stuck two sticks of incense in the snow. These they lit, each tending to his own, and Gan prayed to the spirit of the mountain and the ghosts of his ancestors to give them success in the hunt.

The long prayer ended, Gan turned to pick up his gun, and found that his incense had fallen down and gone out.

"Here is a bad omen!" exclaimed he. "What am I to make of that?"

"The spirits must be angered at some deed of yours. They do not favor our hunt, and I fear that this means some ill besides," answered his companion.

"I will leave the hunt here," said the disappointed young man. "Your incense burns still, Pang-tze; you follow the game. I will see you as soon as you return to the village." With this Gan started off down the mountain, but the other strode out along the ridge in the direction the animals had taken.

It was afternoon when Gan reached Ling-tai-miao once more. Going straight to the inn he found his old friend Shan-liang.

"How has the hunt gone?" inquired the old man.

"Badly," was the answer. "We have found only a badger for our trouble. While I was praying to the spirits my stick of incense fell, and I left the hunt for fear of spoiling my friend's chances. Tell me, is there something wrong in the village?"

"There is trouble, indeed," replied the innkeeper. "A few days ago there came a mandarin with a large following. I had not room enough for them all, so the lieutenant and some others went to Lao Fung's, as his is the largest house. Next morning when they left, they discovered that a valuable robe of snow leopard skin had been stolen. Fung himself is blamed for the theft, though not directly accused. I know nothing of the matter, but the villagers think he is guilty."

"What does he say? Has he any explanation?" asked the smith.

"No, the cowardly old fellow charges his slave, Ma-wu, with the crime."

"That's outrageous!" exclaimed Gan. "But tell me, what could induce Fung to steal?"

"Well, we all know, honest Gan, how bitter he has always been against the mandarins for taking so much and paying so little. So I fancy it rankled when he had to receive this traveler, and feed and attend him, with no chance of payment. Perhaps he decided to reward himself. The whole village knows how avaricious he is."

Just beside the inn door was the booth of the soothsayer of Ling-tai-miao. It was this man's business to tell the people where to bury their dead, when to plant their crops —in short, he ordered the affairs of the community by means of necromancy. When the smith left the innkeeper he consulted this worthy, as he had often done before, and told him of the bad omen that had befallen. The soothsayer interpreted the sign as Pang-tze had done, and directed Gan to satisfy his ancestors by carrying out the plans that their spirits were suggesting to him.

The matter uppermost in the young man's mind was the danger in which Ma-wu stood, so the fortune teller's words meant to him that he was to champion her.

Since that day when he, as a boy, had helped the little slave girl in the street, he had seen her often, and they had been in sympathy, although there had never been much conversation between them. He had seen the child grow into a young woman, and was aware that although she was only a slave, and had not had even the chances of the other village girls, still her disposition was sweeter than theirs. She was prettier, too, for her outdoor work had given her health, and her regular-featured face bore naturally the dainty rose color that the rest attempted to produce with flower stains.

In the early evening Gan went down the long street and into the courtyard of Lao Fung. In the shed that served as a kitchen he found Ma-wu in tears, but still at her work, feeding the fire with bundles of bean stalks, and boiling the rice in the huge kettle.

"Ma-wu," he said in his kindly way, "you work and you cry. Is there something wrong in your heart?"

"Master says the soldiers will come tomorrow, and I must go to prison for stealing a leopard skin. Kind smith, I know nothing of the lost skin. Do not let me be taken away. Here at home they are hard and cruel, but there in prison, they say, people suffer from terrible disease, and die of hunger."

For a moment the helpless girl clung to the young man and felt confident that his strong arm could save her. The open-hearted, unconventional mountaineer was touched by this appeal of innocence, and much distressed on the girl's account. He knew well that nothing could be done without money to buy the interest of the officials, but that Ma-wu might feel a little relieved, he said:

"It is not likely that the runners will come soon. They are never prompt. When they do come I will do all I can. I think I know who really stole the robe, and maybe we can get him taken to prison. You know you have many friends."

At this moment the corpulent and ill-tempered Lu appeared, and seeing the fire out and the rice but half-cooked, she became enraged and beat the defenseless girl with a heavy sash she carried. Gan immediately stepped between the two. Anger was in his eye, but he said not one word. The mistress, dropping her arm, resorted to her tongue, and delivered a tirade of imprecations against the two young people.

Ma-wu was quite used to such treatment, and turned again to her fire and pot. Gan pretended not to hear the old woman, but bowed ceremoniously, and departed without speaking.

Arriving at his home the smith found that Pang-tze had returned. The hunter had killed one of the large goats, and had come back for some one to help him carry the flesh home. He brought with him some of the parts most prized by the villagers, among them the heart and lungs. Gan saw this, and formed a plan at once.

"I cannot return with you, Pang-tze," he said, "but you will find others willing to go, just to get a little of the blood or a taste of the meat." Then after a pause he added, "May I ask a favor of you? I should like the heart and lungs."

"They are yours," replied Pang-tze. "If you could have remained on the mountain with me the animal would have been half yours, anyway."

"I want to talk with old Fung, and I fear he is in a very ill humor," said Gan. "Do me the honor to take these morsels to his shop as you go down the street, and tell him I am coming to see him within an hour."

Lao Fung received the messenger with a scowl, but he accepted the whole of the gift, and sent word that Gan should come at once, if he chose.

The smith and the storekeeper had never been very friendly, but there had been no quarrel, and as the old man knew nothing of the scene which had just passed in the kitchen, he had no pretext for declining to see his caller.

Gan hastened down to the store. As usual Fung was counting his cash, but this time it was a light task, as his sales had been small. He put his rushlight on his counter, admitted the young man through the shutters, and replaced the board he had taken down. The unsteady flame, little more than a spark, illuminated only a small part of the room. The time-blackened walls and dusty shelves which Gan knew to be there were invisible. Invisible, too, were the door into the courtyard and the curtain which separated the shop from an inner room.

Gan's purpose was to endeavor to surprise the old man into some sort of admission of guilt in the matter of the stolen skin, but he had not succeeded in planning a method. He must trust to chance for a favorable moment.

They seated themselves, and Fung began with profuse thanks for the titbits the young man had sent.

"It is nothing, a mere trifle," answered Gan. "I did not even kill the beast myself."

"Indeed," rejoined Fung. "I heard that you had ascended the sacred heights to hunt."

"That's true, but I returned empty-handed. While I was away the spirits told me that some of the village folk were in difficulty. Tell me about that."

Fung started and flushed, and by his undisguised scowl it was evident that this subject was distasteful to him. He disregarded the request, and pretended to be interested in hunting.

"The villagers say you are the best hunter among them, and that you know where to look for the game in winter and in summer. These great wild goats live high up, where the bamboo grass grows, do they not? But tell me, where do the small goats live?"

"They inhabit the rocks and bushes lower down," answered the smith. "At night they seek shelter at the base of the precipices. The deer live lower still, even in the grassy hills. Your slave girl sees them when she goes for fuel. Now say, Lao Fung, why you have accused the girl falsely of theft."

Fung recognized an enemy now, and anger almost got the better of him. He started to rise; the rushlight, fanned by his motion, burned a little brighter, and Gan caught a momentary glimpse of a face in the doorway. It was the face of a strange man, a dissipated, evil face, and one not to be forgotten.

Gan felt that his end had been accomplished with unexpected ease. He had probed the man he suspected, and had seen him lose his composure twice. The smith prepared to depart and said, "As I see you have a guest in the house, I will hasten away."

At this thrust the old man instantly glanced over his shoulder at the door, but he said, "There is no guest. You are mistaken."

Gan paid no heed, but took down the shutter himself, and with a bow, disappeared up the street. As he went home he said to himself:

"By my mother, the old rascal is guilty of the theft, and the girl is innocent, yet justice will not be done. When did that corrupt old mandarin ever do justice? The girl will lie in prison for months before she gets a trial, and then, of course, she will be clapped in a dungeon and forgotten. But this must not be. Money would quickly buy her liberty, but how is a poor smith to find so much silver? I wonder who the ugly face belongs to? Why was the fellow listening, and why is Fung ashamed of his guest?" He lay restless the greater part of the night, revolving these perplexities.

Shan-liang stood at the inn door as usual when Gan came to him in the morning.

"The soldiers are here," said the innkeeper. "They came last night."

"That's evil news, but we cannot hinder them," answered the young man.

"The lazy fellows are not up yet," continued Shan-Liang, "but you won't have long to wait if you want to speak with them."

"I came to speak with you," replied Gan. "I am going on a long journey soon, honorable Shan-liang. While I am absent I turn my shop over to your management."

"But why do you leave the village?" asked the old man. "Are you going back to the abode of your ancestors?"

"No, not there, but—"

His sentence was not finished, for the noisy soldiers came into the room demanding their breakfast. Gan sat watching the slovenly fellows in their tattered and dirty red jackets with black characters on front and back. He did not like the looks of their faces, for they were low ruffians, limited in their evil deeds only by their cowardice. As they ate they talked loudly about the girl they were to arrest, and some made jokes at her expense till Gan grew angry and left the inn.

He went to his house and took his small store of savings from its hiding place. There were but a few ounces of silver in the shape of small, irregular lumps. When he returned to the inn the soldiers had already gone down to the house of Fung.

Gan followed, and on his way bought a large piece of unleavened bread in which he secreted a number of his lumps of silver. The ruffianly soldiers had brought Ma-wu out into the street, and one was holding her by a heavy chain bound round her waist. Blinded by tears, and weak from fright, the poor girl stumbled about as the fellow pulled her from side to side.

Most of the villagers were gathered there. Some jeered and cursed at the soldiers, some spoke kindly to the unfortunate prisoner, but none offered to accompany her to the city, till Gan said:

"Mothers of Ling-tai-miao, why does not one of you go with this maid? Though she be but a slave in name, her father is as worthy a farmer as the husband of any one of you."

Just as he said this, Ming-ta, the innkeeper's wife, came up. She had heard his reproving words, and replied:

"Unselfish Gan, I have made preparations to go. I see I have come just in time."

As they started off down the stony stream bank women wept and shrieked, and men called imprecations after the soldiers, who paid no heed, for they were well used to such scenes.

Gan followed a little way, and when they were free of the crowd he handed the bread to Ma-wu with the caution that she should save it till her arrival, and eat it slowly. He did not tell her of the silver lest the soldiers should overhear.

"Tomorrow I start on a long journey," Gan announced, "But by the second dark of the moon I shall be back. Keep courage, Ma-wu; your innocence is plain to see, and you shall soon be set free." Then facing the leader of the soldiers he said, "Do not hurry the girl so fast over the rough trail. If you must imprison her, put her in a clean cell away from other prisoners, and I will make you a present." With that he handed the fellow a string of cash, almost the last of his savings, and saying a kind word of farewell to the slave, stood till her pathetic figure had vanished around the turn.

Sadder than he had ever felt before, he returned home, now firmly resolved on his course. As he passed up the street Fung stood in his shop alone, with a black look on his face. He had saved himself from the foul prison, but he had lost a dutiful servant, and he was not happy.

III

The soldiers reached the city with their prisoner after night had come. Extremely tired, and with wet feet and muddy clothing, Ma-wu was at once locked in a low cell, without a light, and without furniture. The forlorn girl sat upon the cold brick floor and cried softly, till Ming-ta, who had remained in the street, found her way to the bars that faced the courtyard.

"Innocent Ma-wu, be comforted," she said. "See, I have brought you a good soft matting of straw to lay on the sleeping-platform, a dogskin for warmth, and a quilt to cover yourself. Eat the bread you have tonight, and tomorrow I will bring you millet gruel."

The girl now calmed herself, and undoing the loaf from the sling in which it still hung on her back, began to eat the dry bread. Presently one of the lumps of silver fell on the floor with a little ring. She groped for it, weighed it on her finger as she had seen her master do, and realizing what it was, saw that Gan had actually made an endeavor to help her. One by one the other pieces appeared, until she had a little heap in her lap. It was enough to keep her in food for a long time, if she did not get too badly cheated in exchanging the silver for cash.

Ma-wu began to think of Gan very tenderly. He was a good man to help a poor girl, and so very kind. Why had her older brother not come to her aid in some way? She did not know how nearly her family had forgotten her.

After her food she was somewhat comforted, and began to feel the need of rest, so she groped about in the darkness till she found the sleeping-platform, spread over it the thick straw mat, laid on this the dogskin, and drawing the quilt over her, slept.

To Ma-wu the night passed as if it were but one minute. She awoke to find the kind Ming-ta at her window bars again.

"Ma-wu, here is your gruel," said that good person. "Take it now while it is hot. I have brought this worthy woman to see you. It was at her hut I spent the night.

She is the honorable mother of many sons. You may trust her, and she will take charge of you, for you know I must return to the village."

"Benevolent Ming-ta, you have been as much as a mother to me in my trouble. I grieve to have you leave me, but you must no longer wait on the insignificant slave of your neighbor." Then she spoke to the other woman. "Kind mother, what shall I call you?"

"My name is Hwa-na, and you may call me so, if you like."

"Good Hwa-na," continued the girl, "can you come daily and bring me food? I have silver to pay you with."

It was arranged that Hwa-na should come every morning, bringing gruel and macaroni, and a little boiled pork and salted turnip. Ma-wu parted with her smallest lump of silver to pay for this food.

When Ming-ta had departed a great loneliness came over the girl, and this lasted for days. The old woman was but little comfort, and lacked the kindness of the mountain villagers. When, after some time, the first piece of silver was spent, Hwa-na came to the bars empty-handed, and complainingly asked for more. Then, before the girl could produce another lump, she added that without money no more food could be provided.

Yet there was consolation in the old woman's visits, for she sometimes brought little items of news. One time she came with the information that Gan had disappeared from Ling-tai-miao, and that all the villagers were wondering.

Ma-wu thought, "He has gone secretly on his journey," but she said nothing to the old dame about this.

Day by day and week by week the slave girl sat in the corner of her gray cell, and looked through the bars at the soldiers and the civilians coming and going through the courtyard.

During this time changes took place in the yamen. The old official received orders from Pekin to move to a distant city. A much younger and more energetic man took his place, and being a Chinaman of more than ordinary sincerity and goodness, he was anxious to make a favorable impression on his people. Therefore he commenced soon to hold court and dispense justice among the many prisoners his predecessor had allowed to collect. Some were striped with the bamboo, some were sentenced to long imprisonment, and one or two highwaymen were sent to the provincial capital for execution. Not a few were set free, as already having served a sufficient time while awaiting trial.

So in time the turn of Ma-wu came.

When the slave girl was brought in by her guard the long trial hall was vacant, except for a few soldiers and servants. After a tedious wait, during which Ma-wu trembled with fear and excitement in spite of her desire for self-control, the mandarin entered. He was a shrewd-faced little man in a long purple gown adorned on breast and back with two gold-embroidered pelicans, insignia of rank. His cap was tipped with a purple button. Seating himself at the table which stood opposite the door, he eyed the servants critically. Then he noticed Ma-wu, pale and weak from fright and her long imprisonment. It was so unusual to see a young girl prisoner, that he looked again, and his attention was turned to the business of the day sooner than it might otherwise have been.

"Is this the woman charged with the theft of a leopard skin from a high mandarin?" he asked an attendant.

"It is, Excellency."

"Where are the witnesses? We will proceed."

"There are but two, Excellency. They are entering now."

Lao Fung came in and bowed before the mandarin. His wife, the fat Lu, who followed closely at his heels, did the same. The judge did not return their salutation, but looking sternly at Fung, said:

"Tell me about this theft."

Fung recited in many words how the official had been detained at Ling-tai-miao, and how the robe had been missing the following morning. There was no evidence that anyone had broken in or climbed the wall, so the slave girl was the only one who could be guilty.

Lu gave evidence to the same effect.

The prisoner was called on to speak for herself, but she could do no more than falter a protestation of innocence. Shan-liang and Ming ta were there, but though convinced that the girl was not guilty, they had no defense for her.

The mandarin was unsatisfied with the case, and said, "The evidence against the girl is weak, but as no one appears in her defense, the law requires me to imprison her as a suspect. Witnesses, you may go. Soldiers, remove the prisoner."

The court was adjourned, and the mandarin was about to leave the room when there came the thunder of a deep-toned gong close by.

All started in wonder, and the magistrate stood half annoyed, half expectant, while soldiers ran to stop the intrusion.

It was the gong before the yamen gate, hung there to signify that he who rings may obtain immediate justice, but not for decades had its tone been heard. The instrument had become but a symbol.

The soldiers returned saying, "Excellency, two men stand at the gate, one a prisoner, bound and helpless, the other a strong man who throws us all off, rings, and demands a hearing."

"Admit them both!" cried the judge. "Here justice shall be done as of old."

Then the ringing ceased and there entered Gan, pushing before him a ragged, evil-looking man with hands bound and feet hobbled. Gan glanced at Ma-wu with his cheerful smile. She had sunk to the floor, but on her face was a look of happiness and hope, which it was good to see.

The smith bowed to the magistrate, and to the company; then seeing that he was expected to speak, he addressed the judge:

"Benevolent Excellency, you may well wonder what brings a base smith to intrude on your court in this way. Pursued by the companions of this man in ropes, I was in great haste to gain entrance, but I did not know that my arrival would be so timely. See, I have captured the man who knows all about the leopard skin."

He removed the bandage from the eyes of his prisoner, and turned the man's face first toward the judge, then toward Fung. The brow of Fung grew troubled.

"Stout smith," said the magistrate, "we listen; explain your meaning."

"Illustrious Judge," continued Gan, "I am the smith of Ling-tai-miao. Like all the villagers, I knew this girl was innocent, and I resolved to ransom her with money. Therefore I went on a long trading journey into distant provinces, and on my return I stopped one night at the town of Pau-chong. There in the inn I overheard this man telling with laughter how Lao Fung had sold him the leopard skin that had been stolen. I recognized his face, for I saw him once at the house of Fung. That night I slept near him and watched, and in the morning I overcame and bound him."

Pointing suddenly at Fung he exclaimed, "There is the real thief! This wretch in the ropes is the King of the Robbers of your own city!"

Gan had spoken with such directness and vehemence that his words convinced his hearers at once.

"Imprison this Fung!" shouted the judge. "Put him in a wooden collar, and make it tight about his throat. Soldiers, you must know this miserable man whom the smith has brought. Is he the King of Thieves? Answer me!"

Reluctantly a spokesman of the soldiers admitted that he knew the chief of thieves, and that this man was he.

"Then put him in a dungeon!" commanded the magistrate. "I will sentence him tomorrow."

The two prisoners were hurried away, and the official, turning to Ma-wu, said:

"Young woman, you are free to go. The smith has saved you many a day in prison.

"Stout and honest smith, your capture of the thieving beggar is worthy of reward. If you wish to enter my service you shall keep my mules shod, and the guns of the troops in repair."

"Great Man," answered Gan, "I sun myself in your benevolence, but I am of the mountains and the forest, and the gray walls of the city are hideous to me. Therefore I cannot take your offer. But if you wish to favor me, give this maiden freedom from her bondage to Fung. She has served him well for years, and her work has paid the debt her father owed, thrice over."

A few strokes of the official pen gave Ma-wu her freedom, and the two left the yamen in happiness.

The exonerated maiden was received with kindness in the village, and was taken to the house of Ming-ta.

One morning before many days had passed, she left the inn clad in a gown of crimson, and seated in a palanquin all decked with crimson cloth. Her four chair-bearers came to a stop close to the smithy door, and the bride slipped out into her new home, amid the sound of loud music and the applause of the villagers, who had gathered to the feast.

The Needed Art Galleries for New York

By HOWARD RUSSELL BUTLER[1]

President, National Academy Association

THE forces of creative art of any country naturally concentrate in its largest and most active metropolis. It is there that the organizations of workers in all the branches of art can best come together and unite their efforts. Individual artists may well pursue their calling in any part of the country, but they must keep in touch with the art center.

In this way the city of New York has undeniably served as a center for the art activities of the entire country. It is said that the first art school was founded in New York by Archibald Robertson about 1792. The New York Academy of the Fine Arts was proposed in 1802 and incorporated under the name of The American Academy of Fine Arts in 1808. The New York Drawing Association was founded in 1825—the National Academy of Design growing out of it in 1826. There have since been organized the American Water Color Association, in 1866; the New York chapter of the American Institute of Architects, in 1867; the Architectural League of New York, in 1881; the New York Water Color Club, in 1890; the National Sculpture Society, in 1893; the National Society of Mural Painters, in 1895; the Society of Illustrators, in 1902; and many others.

These organizations have their headquarters in New York City, but their membership is drawn from all parts of the country. That of the National Academy of Design is scattered through more than thirty states and about ten foreign countries. These organizations are almost exclusively of professional workers. From their membership has come and is coming the major part of the original work in the fine arts of this country. Whenever an important exhibition takes place in the eastern, southern, or western section of the United States, the works displayed are very largely drawn from the art organizations of New York City. Thus the exhibitions of Pittsburgh, Chicago, Philadelphia, and St. Louis have counted largely on work by the members of the New York societies. Frequently from forty to sixty per cent of the paintings in these exhibitions are executed by members of the National Academy of Design.

In the smaller cities the art schools, the art museums, and the exhibitions of current art are generally combined in one movement and housed in a single building. But in the main art centers these divisions are so important in themselves, that they may better exist as independent movements.

The vital, living art of a country is one thing, and the collecting of the art of the past another. The art patron therefore has open before him two channels. He can directly aid the art of his own country by stimulating the best production of living artists and encouraging their exhibitions; or he can bring together permanent exhibitions of ancient and foreign and past domestic art in the galleries of a museum. Both lines offer effective aid in awakening an interest in good art throughout the country.

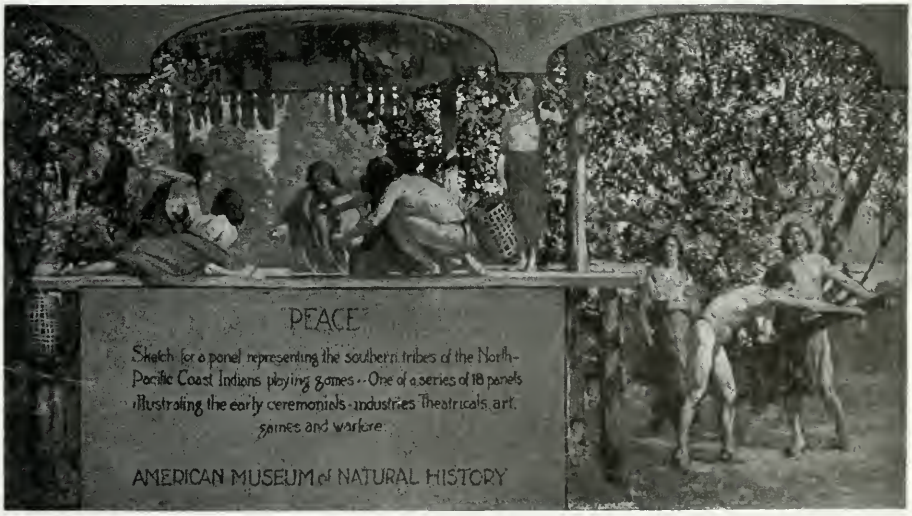
Of late the museums have enjoyed great prosperity, and their phenomenal growth has done much to establish standards of excellence, *indirectly* benefiting native art. But far less attention has been given *directly* to native art. It has not only lacked patronage, but it has lacked the facilities of exhibition, and has had to get along as best it could, so that the fight for bare existence has proved long and tedious. The struggle of the National Academy of Design for a home, ever since it was obliged to leave its old location at Twenty-third

[1]Artist of "The Solar Corona," a canvas showing the total eclipse of the sun of June 8, 1918, presented to the American Museum by Mr. Edward D. Adams and now on permanent exhibition in the west assembly hall of the Museum building. Mr. Butler is known to readers of NATURAL HISTORY through his article on "Painting the Solar Corona," published in the March number (pp. 264-271), 1919.

Street and Fourth Avenue in 1896, has thus far been a discouraging one. For more than twenty years it has held its annual exhibitions in the Fifty-seventh Street building. It has been compelled to hold two exhibitions each year because of the limited space, and yet the walls have had to be unduly crowded. Many able artists have hesitated to have their works seen under such conditions, and so the exhibitions have suffered in quality. The destruction by fire of these galleries last January again brings this important question to the front. Not only the National Academy, but all the other art societies of the city, are calling for adequate quarters and exhibition spaces. This mutual desire has led to the formation of the National Academy Association, a union of ten societies, headed by the Academy, and having for its one great object the erection in this city of a handsome edifice which shall be both an ornament to the city and a home for all the forces of native art. But thus far the efforts to secure this building have been fruitless, and the anomalous condition exists today that the city which is the center of the creative art of the country has no sufficient place from which the influence of that art can radiate.

A great exhibition building, with permanent quarters for these organizations, and adequate galleries in which displays can be made of the annual output of the studios, such as appear in the Salons of Paris and the galleries of the Royal Academy of London, is needed. The city has a right to be proud of its commanding position in the realm of creative art. Why, then, should there not be a movement to crystallize that position and give it a proper setting, so that New York may be acknowledged by the entire country as the home of native art, just as the entire country now thinks of it as the home of the great Metropolitan Museum?

It seems to me that here is an opportunity which might be welcomed by one or more enlightened citizens who realize the value of living art and the services of the living artist to the community, to come forward and provide the needed building,—a home center of American art,—thus at once encouraging the artist, enriching the city, and erecting to his or their own fame an enduring monument.



A small section (somewhat to the right of the middle) of a copyrighted sketch for an Indian mural by Mr. Will S. Taylor. This is a panel twelve by sixty feet, designed for the north wall of the North Pacific Hall of the American Museum, which will take its place between a series of eight murals on the west wall showing industries and eight on the east showing ceremonial life. The panel presents the Indians of southern British Columbia at play—those at the left are gambling with a sort of "Button! Button! Who's got the button?" game, while the man in the foreground at the right has just thrown his spear through a hoop

Without the Aid of Eyesight

It is with the permission of Author and of publishers, Henry Holt & Company, that we give the following brief quotations from *Hitting the Dark Trail*, by Clarence Hawkes

"THEN little by little the meaning of all my years of blindness was made plain to me. If I had always retained my sight, I should have gone on . . . learning of nature from reading her great book without ever stopping to think what the things that I saw meant. I must have gone on hunting and trapping, fishing and camping, without ever having gathered together or arranged my knowledge.

"This then was my way out. I had lost my eyesight in the deep woods, with a gun in my hand, in the very hour of despoiling nature. I would turn about and tell the American boys and girls all these intensely interesting things . . . I would show them the life of field and forest from the side of the hunted. I would try to get the attitude of all my little furred and feathered friends, and put it into books. I would teach children not only to know and love the birds and squirrels, but also to care for them, and to help them in their unequal struggle. . . .

"Living as I do in a country village, with the world of nature all about me, I am still able to do much very effective nature study, and to gather a few interesting facts each year. My home faces upon the broadest and most beautiful street in the world, which is flanked by four rows of enormous elms. From that happy day in March when the first bluebird perches upon the tiptop branch of one of these trees and greets me with his sweet little 'Cheerily,' until he flies away in the Autumn, one of the last of the song birds to leave, this wonderful street is an aviary of no mean order. I am able each year without going out of my street to identify more than fifty species of birds. At the back of my house is a small orchard which is a favorite nesting place of the birds, and here I discover a few more species that do not ordinarily frequent the street. In company with some one who has good eyes, with an opera glass and a bird book, I pass many happy hours while the silver-footed moments of Summertime go by. . . .

"It would surprise one of the uninitiated to know how much I can observe of the out-of-doors, either in field or forest, or on lakes and streams, wholly by myself without the aid of eyes. My hearing for the slight sounds of nature is so keen, and my senses are so quick to detect new clues either by sound or scent, that I am just as apt to discover the new and wonderful things as are my seeing friends who accompany me. In the Spring I hear more wild geese go over than does any one else in the vicinity, because my ears are unconsciously keyed to catch their stirring water slogan. To the trained ear every rustle and every snapping twig in the forest means something, and all these slight sounds tell their own story.

"I would not need to ask anyone to identify many of these sounds for me. The steady trot, trot, trot, of a fox is no more like the uneven hopping of a rabbit than the galloping of a horse is like his trot. A bird and squirrel never rustle the leaves of a tree in the same way. The scratching of small squirrel feet down the bark of a tree is as unlike the similar slight sound made by a woodpecker traveling up the bark as can be imagined.

"The bird language also I probably understand much better than a man with sight ever could, for all the little intonations are so clear to me. Happiness, fear and alarm, querulousness, good spirits or pain, all are conveyed by my little friends in a language as plain as the spoken word. Only it takes the ear to hear, and the heart to understand these things."

Courtesy of Ernest Harold Baynes

During the hard winter even sturdy blue jays appreciated the friendliness of their human neighbors

Aquatic Preserves

By A. S. PEARSE and CLYDE B. TERRELL[1]

ONLY during the last few years have sportsmen and those interested commercially in aquatic resources come to realize that results from water crops depend on intelligent planting and care just as much as from crops raised on land. A hundred years ago the United States was rich in game, fish, and fowl. Herds of bison roamed over the western prairies; elk and beaver were being killed and trapped in the suburbs of Chicago by the Indians. Nobody spoke of conserving anything. A hundred years hence there will be no "wild" country except in deserts and national parks. The advance of civilization gives increasing interest to preserves for all those who love animals.

The vegetation is the dominant factor in any aquatic preserve. It furnishes food for birds, fishes, and other animals. Without this fundamental resource the game will not be present. Moose like to stand shoulder deep and feed on succulent water plants; ducks dive for the luscious wild celery—the recent work of McAtee shows that wild ducks feed on a wide variety of aquatic plants; in Wisconsin more than 20 per cent of the sunfish's food consists of aquatic vegetation. In addition to such direct contributions to the food resources of wild animals, the aquatic plants do a still greater service by supporting a host of small vegetable eaters, such as insect larvæ, crustaceans, and snails. These are eagerly sought by many animals which feed in the water. Water plants also furnish shelter for many animals—particularly for immature forms.

Several years ago the junior author of this article began a study of aquatic preserves with the purpose of learning how to make attractive, natural homes for fishes and birds. This work has been continued with increasing success and patronage up to the present time—the clients being found mostly among game clubs, owners of large estates, and conservation commissions. It has been necessary to study the stomach contents of fishes and birds at various seasons of the year; to spend long hours in the field trying to discover just what makes certain habitats more "attractive" than others; to glean from the literature on the subject hints which would help to make the work a success. Many mistakes have been made and some phases of the work are still far from satisfying, but—we have learned! At present a permanent staff of employees is maintained. The men collect aquatic plants in the open season and are kept busy trapping in the winter.

Wild duck's nest on a planted game preserve, Oconomowoc, Wisconsin.—As wild life is more and more restricted to limited areas with the increasing settlement of the country, the scientific care of public and private preserves becomes of the utmost importance. In the case of waterfowl and game fish, and even of many of the larger mammals, the pond and stream vegetation is a paramount factor in their conservation, for it is from the aquatic plants that directly or indirectly they gain their food

[1] The senior author, Dr. A. S. Pearse, is associate professor of zoölogy at the University of Wisconsin; the junior author, Mr. Clyde B. Terrell of Oshkosh, Wisconsin, who took the photographs used in this article, is a specialist on the development of attractive places for birds, game, and fish.

At first the keeping and transporting of the propagative material caused us trouble. Wild rice seed gives its highest germination test if kept damp, and will not grow at all if allowed to become entirely dry. The seeds of most aquatic plants will not keep indoors in bins as do ordinary farm and garden seeds, but will do best if stored in bags beneath the ice in a lake or stream—where they must of course be kept below frost. They will also keep well if placed in loosely filled, wet sacks, laid flat on cakes of ice, and covered with damp sawdust. A foot of sawdust is sufficient to keep the seed cool in hot weather and four feet will prevent it from freezing during the winter. The list given below states the particular value of each plant and the proper time for planting.[1]

The problem presented for solution by the owner of a preserve is usually the increase of production—of fishes, of wild fowl, or of both. Fortunately the general principles involved in providing attractive homes for fishes and waterfowl are much the same. We believe that it consists primarily in providing an abundance and variety of aquatic vegetation. This view has been supported by extensive plantings in Michigan, Tennessee, Texas, New York, and other localities. Recently in Wisconsin the Chippewa River was dammed, and Lake Wissota, a beautiful body of water fifteen miles long, came into being. This lake by the judicious use of the proper aquatic plants has been advanced several years ahead of what it would be if succession had been left to "nature." Fishes have increased in numbers rapidly and ducks are becoming more abundant.

In putting out aquatic crops one must exercise as much care as would be taken when sowing seeds on land. Wild rice will not do well in a landlocked lake. It requires some current or change of water, but does best in sheltered bays or sloughs where the plants are not disturbed by swift currents or the wash of waves. If plantings

[1] THE PLANT—Its Value	Where to Plant	What to Plant	When to Plant: No. U.S. & Canada	When to Plant: So. U.S.
Wild Celery (*Vallisneria spiralis*)—Unfailing attraction for canvasbacks, redheads, bluebills. Best fishing where it grows, provides food, shelter, keeps water fresh and clear insuring more fish reaching maturity. Submerged.	1½ to 12 ft. fresh or slightly brackish water. Sand, loam or mud soil. Soft rich soil and 2 to 7 ft. water best	Winter buds-Tubers	March 1—June 25	
		Plants	May 15—July 25	May 15—Aug. 10
		Seeds	Sept. 15—Nov. 1	
Duck Potato or Wapato (*Sagittaria latifolia*)—Exceptionally attractive to practically all varieties of waterfowl. Handsome decorative plant. Dark green arrow-shaped leaves, white and yellow flowers. Grows rapidly.	Shallow waters, 1 inch to 18 inches deep; marshy muddy spots	Tubers or Plants	Mar. 15—July 15	Feb. 15—Aug. 1
Wild Rice (*Zizania aquatica*)—Exceptionally fine attraction for mallards, teal, pintails, black duck, geese, etc. Forms attractive clumps and backgrounds for water gardens. Early giant variety best.	Sheltered waters, not salty to taste, ½ to 3 feet deep with visible outlet. Prefers rich soft soil	Seeds	Sept. 15—June 15 When not frozen	
		Plants	Apr. 15—June 15	
Sago Pond Plant (*Potamogeton pectinatus*)—Submerged plant. Seed size of wheat. Tubers and tender vegetation attract practically all wild ducks, especially teal. Food and shelter for fish.	1 to 6 feet fresh or brackish water	Tubers and Roots	Apr. 1—July 1	Feb. 1—July 15
		Seeds	Aug. 15 to Nov. 1	
Broadleaf Pond Plant (*Potamogeton natans*)—Good for fish ponds. Desirable wild fowl attraction. Submerged.	1 to 8 feet fresh water. Fairly rich bottom	Roots	Apr. 1—July 15	
Brownleaf Pond Plant (*Potamogeton crispus*)—Floating leaf. Attracts black duck, mallards, teal, etc. Fish usually found around it.	Fresh or brackish water. 1 to 4½ feet deep	Roots	Apr. 15—July 15	
		Seeds	Aug. 15—Nov. 1	
Duckmeat (*Lemna*)—Attracts both wild ducks and fish. Floats, not attached by roots, therefore will grow over either poor or rich bottom.	Small ponds, ditches or bays where practically no waves	Plants Submerged Variety	May 1—Aug. 10	May 1—Sept. 1
		Plants Floating Variety	May 15—Aug. 10	May 15—Sept. 1
Bulrush (*Scirpus*)—Cover and food for waterfowl. Backgrounds or clumps for water gardens.	Fresh water; 1 to 4 feet deep. Grows on rich or sandy soil	Roots	Apr. 1—July 15	Apr. 1—Aug. 1
Wild Duck Millet (*Echinochloa crus-galli*)—Food and cover for domesticated and wild waterfowl, quail and other birds. Desirable background.	Land around edge of water. Land out of water in summer	Seeds	Apr. 1—June 20	Mar. 1—Aug. 1.
Water Milfoil (*Myriophyllum*)—Excellent plant for fish ponds and aquariums. Attracts many waterfowl.	Quiet ponds, streams, fairly rich soil, 1 to 4 feet fresh water	Plants	Apr. 15—July 15	

(Continued on opposite page)

A game preserve in the eastern United States, showing planted pickerel weed, water lilies, and sedges.—To understand just what will make a habitat most attractive to the desired wild visitors requires extensive study of their food habits, of the vegetation which will successfully flourish on a given pond bottom, and of the enemies from which both the plants and animals must be protected

are made at the mouth of a stream, the spread against the current will be very slow, but those toward the headwaters will soon propagate downstream. Proper bottom is of course necessary, and wild rice does best in soft dark mud. Seeds or tubers are more likely to become established if not planted among a dense growth of other vegetation, which, like weeds in a garden, may choke out the plantings. When it is desired to make plantings in places where there is thick vegetation, it is best to rake out spots in which to sow the seeds. The surrounding growth will protect the planting from waves, swift currents, and the depredations of animals. A variety of aquatic plants is desirable in a preserve, because the season of production and of "attractiveness" for fish and fowl is prolonged.

Plants must often be given protection for a time after they are put out. Cattle or deer may devour an entire planting before it has had a chance to become established. The carp, which fishermen have well named the "water hog," may root over an area of bottom, devouring seedlings in great numbers. Muskrats and snapping turtles cut off and destroy wild celery. It is usually de-

COONTAIL (*Ceratophyllum demersum*)—Desirable submerged plant for waterfowl and fish.	Still waters; floating plant; will grow over either rich or poor soil	Plants	June 1—Sept. 1	June 1—Sept. 15
ELODEA (*Anacharis*)—Submerged plant. Especially good for fish ponds, aquariums, domesticated and wild waterfowl. Rapid grower.	Fresh water ponds, streams or bays. 1 to 8 feet deep. Quiet or slow current	Plants	May 1—Aug. 1	May 1—Sept. 1
MUSKGRASS (*Chara*)—Attracts wild ducks. Recommended for fish ponds.	Fresh or slightly brackish water containing lime (indicated by shells)	Plants (with oögonia)	May 1—Oct. 15	
PICKEREL WEED (*Pontederia*)—Duck food. A handsome ornamental plant. Purple flowers.	Shallow fresh water, 1 to 3 feet deep; fairly rich soil	Roots or Plants	May 1—July 1	
WATER CRESS (*Radicula nasturtium-aquaticum*)—Duck food. Green all winter in unfrozen streams. Salads. Ornamental.	Shallow streams, springs, fountains. 1 to 8 in. water remaining open in winter	Plants	Mar. 1—Aug. 15	Mar. 1—Oct. 15
WIDGEON GRASS (*Ruppia maritima*)—Submerged wild duck food.	Slightly brackish or saline water. 1 to 5 feet deep	Roots or Plants	May	June
EEL GRASS (*Zostera marina*)—Good duck and brant attraction for salt water.	Shallow salt water, bays, etc.	Roots or Plants	Apr. 1—Aug. 1	
WATER LILIES—Attract waterfowl. Provide food and shelter for fish. Ornamental. Handsome flowers.	Tubers and Plants 1 to 5 feet quiet, warm fresh water. Fairly rich soil	Tubers or Plants all varieties	Apr. 15—July 1	Mar. 1—Aug. 1
American Lotus (*Nelumbo lutea*). White (*Nymphæa odorata*). Yellow (*Nuphar advena*). Banana (*Castalia mexicana*).	Seeds 1 to 3 feet deep	Seeds Amer. Lotus Yellow	Apr. 15—July 1 Start earlier inside and transplant Aug. 15—Oct. 1	Mar. 1—Aug. 1
CANES, QUILLWORT (*Arundo donax*)—Provide cover and shelter. Grow 5 to 8 ft. high. Clumps look well in water gardens.	½ to 2 feet, fresh water	Roots	Apr. 1—July 1	

The wapato, or duck potato (*Sagittaria latifolia*), is an ornamental plant which grows rapidly wherever introduced. It is a favorite food of wild ducks and of muskrats

sirable to make large plantings in several places in a tract. This increases the chance that the crop will become established. Large browsing animals and carp may be kept away from a small bed by using wire netting. Carp may be kept down by draining or seining. Muskrats and turtles can be trapped.

Although vegetation is the matter of chief importance in establishing and maintaining a preserve, there are other factors which are essential. There must be some good rich bottom "soil" and some bare bottom. For most fishes and for all ducks the fauna of the bottom mud and the aquatic vegetation is a much more important source of food than that furnished by the plankton (the small organisms swimming in the water itself). Plant growths in themselves enrich the bottom after a time, but in small ponds it is sometimes well to use fertilizers. In Germany and China the yield of fishes from a small pond has been increased by adding manure.

We are loath to admit it, but there may be too much vegetation. The fishes which do best in weed-choked ponds and swamps are the mud minnow, stickleback, and bullhead—all of little value to man. The best game fishes cruise along the borderline between the shore vegetation and open water. Many of our most desirable fishes require bare bottom for spawning. These facts and others make it safe to say that it is wise to have some bare bottom and some open water in any preserve. Sandy or stony "bars" are particularly useful, and in a pond may be introduced artificially by hauling a few loads from a gravel pit.

In a small body of water where fish or ducks of the same species are kept year after year, the stock may become infected with parasites to such an extent as to be of no value. There are small lakes in New York where most of the worth-while fishes are "grubby." A trout hatchery in Wisconsin which has almost ideal physical conditions (pure spring water and fine stream bed) is of little value because it is infested with enormous numbers of parasitic crustaceans which kill the trout by attacking their gills. In order to prevent a too abundant growth of aquatic vegetation and lessen danger from parasites, many hatcheries "rotate" their ponds. In regular order they are drained and allowed to lie idle over winter, so that they may "freeze out."

One final point in regard to restricted fishing in preserves. Many times people wonder why the fishing is "not what it used to be when I was a boy," although fishing has always been limited strictly to "sportsmen's methods." Angling, if practiced alone, will cause the game fishes to decrease and allow others to increase disproportionately. A body of water can support only a certain number of fishes. To keep a balance between the species it is usually desirable to allow supervised seining or fishing by other means to keep down fishes like the carp, sucker, dogfish, and gar, which seldom take a hook.

Scientific Zoölogical Publications of the American Museum

SUMMARY OF WORK ON WHALES

By FRANK E. LUTZ

ONE of the most curious of whales is the pygmy sperm whale, *Kogia breviceps*. Although very rare in this part of the world, a large individual of this species became stranded a year or so ago at Long Beach, Long Island, and its skeleton was soon after added to the great collection of cetacean material which Mr. Roy C. Andrews has made for this Museum. The specimen was a female and very fortunately contained a full-grown fœtus which was preserved in alcohol for future study. When whales are launched into the world they are almost like small models of their gigantic parents; so here was an opportunity for some intensive studies of the anatomy of this animal, studies which could be carried out far more effectively on a fœtus forty-four inches long than on an adult carcass of many tons' weight. The fœtal specimen was accordingly intrusted to Prof. H. von W. Schulte, then of the department of anatomy, Columbia University, and his associates, who are coöperating with Mr. Andrews in a series of studies on cetacean anatomy.

Adaptation and Construction in Whales

Out of the great mass of special observations recorded in a paper[1] by Dr. Schulte and Dr. M. de Forest Smith, of the College of Physicians and Surgeons, Columbia University, we may select for present notice only a few of the more general facts, such as exemplify the marvelous construction of whales, a construction which enables these highly transformed descendants of land-living mammals to move in the ocean with great power, endurance, and speed, and even to descend to surprising depths.

Concerning the *panniculus*, or outer mantle of muscle covering the fore part of the body, the anatomists conclude that its great development serves not so much in moving the flipper as in maintaining pressure upon the body cavities so as to prevent their distension by air pressure from within when the animal rises from deep water.

Beneath the *panniculus* was found, as in other whales, an arrangement of the musculature of the fore limb which is a special modification of the normal mammalian type, as shown in the accompanying figure. But adaptation for swimming and diving has progressed so far that certain of the normal muscles of the fore limb (such as the biceps, the pronators and the supinators) have been lost or much reduced, while others, such as the deltoids and the extensors and flexors of the hand, have been greatly increased.

The tail being the principal organ of locomotion, the musculature of this region is much developed, especially along the high spines of the backbone. The strong muscles of the under side of the body play an important part in regulating the pressure of the water against the viscera in diving.

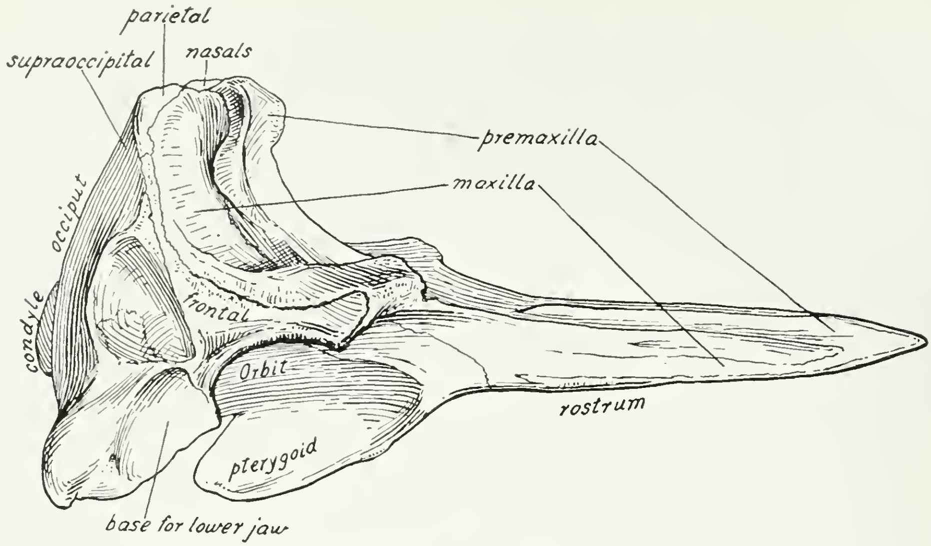
So thoroughly has adaptation impressed itself upon construction that the arrangement of the spinal nerves and their numerous branches loses much of its normal mammalian intricacy and, especially toward the rear of the body, takes on a secondarily simplified segmental pattern which is superficially suggestive of the arrangement of these nerves in fishes.

On the Anatomy of the Pygmy Whale

A paper[2] by Dr. J. D. Kernan, department of anatomy, Columbia University, and Dr. H. von W. Schulte is partly a confirmation and extension of the accounts of Benham and le Danois of the anatomy of *Kogia*, their material, however, being adult, while Doctors Kernan and Schulte deal with the fœtal specimen already mentioned. After considering the form and function of the many curious organs of the respiratory tract and viscera, the authors conclude their

[1] Schulte, H. von W., and Smith, M. de Forest. 1918. The External Characters, Skeletal Muscles, and Peripheral Nerves of *Kogia breviceps* (Blainville). *Bull. Amer. Mus. Nat. Hist.*, XXXVIII, Art. 2, pp. 7–72. [Review furnished by Dr. William K. Gregory.]

[2] Kernan, J. D., Jr., and Schulte, H. von W. 1918. Memoranda upon the Anatomy of the Respiratory Tract, Foregut, and Thoracic Viscera of a Fœtal *Kogia breviceps*. *Bull. Amer. Mus. Nat. Hist.*, XXXVIII, Art. 8, pp. 231–67. [Review furnished by Dr. William K. Gregory.]



Side view of the skull of Cuvier's whale *(Ziphius cavirostris)*, showing some remarkable structural adaptations to resist the pressure of the water and the twists and strains upon the prolonged rostrum, caused by the powerful forward thrust of the body in swimming and diving. The back part of the skull (occiput) forms a wide, firm base (which could be seen best, of course, in a view of the skull from underneath instead of from the side) which receives not only the backward thrusts transmitted through the rostrum, but also the forward thrusts upon the condyles coming from the backbone. The upper part of the skull is braced by a massive transverse crest formed by the supra-occipital, parietals, nasals, maxillæ, and premaxillæ; these bones are piled up into a sort of wide dome through which passes the vertically placed tube leading to the nostril at the summit. The premaxillæ and maxillæ thus not only form the upper part of the rostrum but are prolonged backward and upward on to this dome in order to support the massive "case" or spermaceti organ, which is a specialized part of the nose

paper with a section on the auditory apparatus, containing the following interesting paragraphs:

"The auditory apparatus of *Kogia*, as in other Cetacea, has thus been modified from an apparatus designed to receive air-borne sounds to one designed to receive water-borne sounds. The external meatus has been practically closed, the drum membrane fixed, and the ossicles rendered immovable by the fusion of the malleus to the os tympanum. Denker has thoroughly demonstrated that vibration of the ossicular chain is impossible. The water-borne sounds are evidently transmitted to the cochlear apparatus through the solid tissues of the head. This method of hearing is all the more efficient on account of the closing off of sounds borne through air, in accordance with the well-known clinical fact that bone conduction is increased where the function of the middle ear is diminished.

"The manner in which the sounds are transmitted to the cochlea is disputed. Some authorities maintain that the vibrations are transmitted to the air in the tympanum, and thence to the cochlea through the fenestra ovalis. Others say that the sound waves reach the receptive organs in the cochlea directly through the walls of the periotic bone. In this connection, it is important to recall that the os tympanum and the periotic are nowhere in contact with the other bones of the skull and that they are surrounded by numerous cells capable of distension with air. So it seems necessary to suppose that sound waves must reach the internal ear through a cushion of air immediately related to the periotic, though not necessarily that contained in the tympanum alone.

"The large relative size of the cochlear division of the periotic argues an active hearing function. On the other hand, the comparatively small size of the semicircular canals is what we should expect in an animal living in the water where little active balancing would be called for."

Architectural Features of the Whale Skull

Dr. Kernan has made a most thorough and detailed study[1] of two skulls of the

[1] Kernan, J. D., Jr., 1918. The Skull of *Ziphius cavirostris*. *Bull. Amer. Mus. Nat. Hist.*, XXXVIII, Art. 11, pp. 349–94, Pls. XX to XXXII. [Review furnished by Dr. W. K. Gregory.]

curiously specialized whale, *Ziphius cavirostris,* the one being that of a young adult female, the other that of a fœtus. The most interesting part of this paper for the general reader is the discussion of the architectural features of the skull, which enable it to resist various physical forces acting upon it in life.

"Three classes of forces may be thought of as acting upon the skull of cetaceans: water pressure; the vertical and lateral twists and strains upon the prolonged rostrum; and those incident to propulsion, due to the resistance of the water in front and the thrust of the vertebral column upon the condyles behind." (See page opposite.)

The New York Aquarium Guide Book

THE New York Aquarium has recently published under the authorship of Dr. C. H. Townsend, the director, a new *Guide,* attractively illustrated with photographs of many of the animals on exhibition. An introduction gives a brief history of the Aquarium, which is the largest in the world, and some interesting notes on the problems of maintaining and transporting fishes from tropical or northern, fresh or marine habitats. Strangely enough, showy tropical species are more easily cared for than local fresh or marine species. The importance of the temperature factor limits the life of many species in the Aquarium. Fishes from cold waters can exist only in winter in the Aquarium, as it is impossible in summer to keep the temperature of the water low enough. The converse is equally true. Limitations of space prevent the housing of more than about two hundred species in the building at any time.

The *Guide* gives brief accounts of about 150 of the most common aquarium fishes, both marine and fresh water, with such factors as range, economic importance, value for sport, and interesting habits. As the species are all arranged by families in the accepted scientific order, an excellent idea of their relationships can be obtained. The remainder of the book deals with turtles, alligators, frogs, salamanders, marine mammals, and invertebrates, on the same plan, although owing to the difficulty of providing proper habitats in the Aquarium, the number of species exhibited is necessarily much smaller. The Mosquito Hatching Exhibit in connection with the invertebrates has proved particularly attractive to visitors. A chapter on "Balanced Aquaria," and another on the "Care of Small Aquatic Animals," the latter contributed by Ida M. Mellen, present brief summaries of experience of value to all amateurs.—LUDLOW GRISCOM.

Notes

A COMMITTEE has been appointed by the friends and relatives of the late Dr. Henry Marcus Leipziger to found a memorial for him. The plan is to conduct annual lectures upon important subjects, and $10,000 of the desired $50,000 has already been pledged for the purpose.

DR. C. GORDON HEWITT, consulting zoölogist of the Canadian Conservation Commission, died at Ottawa on February 29, in his thirty-fifth year. Dr. Hewitt was one of the foremost champions of wild life conservation in North America. He will be remembered in that connection by readers of NATURAL HISTORY for his account of the "Coming Back of the Bison" in the December, 1919, number. He had been engaged for the last four years in the preparation of a book on the conservation of wild life in Canada which was completed shortly before his death and which will appear posthumously. Dr. Hewitt's services in connection with the ratification of the treaty between the United States and Canada for the protection of migratory birds were invaluable and brought recognition in 1918 from the British Royal Society for the Protection of Birds with the award of their gold medal.

THE American Museum through its department of ichthyology has received from

Dr. David Starr Jordan a gift of three slabs of diatomaceous earth containing fossilized fishes.

Dr. Herbert J. Spinden, of the American Museum, has been elected a corresponding member of the Society of Americanists of Paris.

The Lalande prize in astronomy of the Academy of Sciences of Paris has been awarded to Dr. V. M. Slipher, director of the Lowell Observatory, Flagstaff, Arizona.

Dr. Hugh P. Baker, dean of the New York State College of Forestry, has resigned from that institution to become secretary of the American Paper and Pulp Association. In his letter of resignation Dr. Baker stated that he accepted his new position as an opportunity to carry the profession of forestry into a great industry.

Dr. Jacques Loeb, head of the department of experimental biology at the Rockefeller Institute, was elected president of the American Society of Naturalists at their annual meeting in Princeton.

Mr. Felix M. Warburg, chairman of the Joint Distribution Committee of Funds for Jewish War Sufferers, and a trustee of the American Museum, has been notified by the Polish Minister of the award to him of a medal in recognition of his services in the relief of Poland.

Owing to the delayed date of printing this issue of Natural History we are able to include the following item:

The late Rear Admiral Robert E. Peary was awarded the first medal to be given by Kane Lodge, 454 F. & A. M., at the centenary celebration of Elisha Kent Kane's birth, which was attended by many distinguished explorers on March 30. The gold medal, which bears the seal of the Lodge and portrays an Arctic scene, was accepted by Peary's sixteen-year-old son. It is the first of a series to be presented "to those who by predominant achievement have added to the knowledge of mankind in those parts of the earth's surface previously unexplored or undeveloped."

The Agassiz Medal of the National Academy of Sciences, Washington, for research in oceanography, was awarded in 1919 to S. A. S. Albert I, Prince of Monaco.

President Henry Fairfield Osborn, of the American Museum, and Mrs. Osborn were recent visitors at Hilo, island of Hawaii, whence President Osborn journeyed to the active volcano, Kilauea, in company with Dr. Thomas A. Jaggar, director of the Hawaiian Volcano Observatory, and to the great forest reserve near Pahoa. From Hilo Professor and Mrs. Osborn will go to the island of Maui and perhaps also to Kauai and Niihau where primitive Hawaiian communities still maintain something of their ancient ways.

Mr. Roy Chapman Andrews, of the American Museum, has returned after an absence of nearly two years. Mr. Andrews was in charge of the Second Asiatic Zoölogical Expedition which the Museum sent out in 1918 to carry on zoölogical work in North China and Mongolia. A large collection of mammals was obtained, among which are mountain sheep holding the world's record for size, elk, moose, antelope, goral, wild boar, tiger, and serow, as well as more than a thousand small mammals.

Professor T. D. A. Cockerell in a recent number of *Science* tells of Darwin's method of investigation. He was a most faithful and persistent worker, and in addition he constantly sought the coöperation of friends and correspondents among his contemporaries. *The Origin of Species* reveals by its acknowledgments the great number who helped him. He directed and unified the experiments of others, acting as leader of an interrelated group, and thus his work has both the breadth and the accurateness that one man alone could not attain. In this respect Darwin worked under conditions different from those which confront present-day biological scientists, whose work is delegated to but one department of an institution, and the question may well be asked if we are not overdoing individualism.

Several of the microscopical trouble makers possible to our water supply, mentioned by Dr. Kahn in this number of Natural History, are to be seen among the glass models in the Darwin hall at the American Museum. These include *Synura uvela* (page 83) and *Volvox globator* (p. 85, No. 3 at the right) which impart respectively the cucumber and fishy odors found in reservoir waters, and also *Gonium petrocale* (p. 85, No. 6 at the right) and the pond-frequenting *Stylobryon petiolatum*. The glass models of animalcules, enlarged many hundred diameters, were blown by Mr. H. O. Mueller, of the Museum's preparation staff, to illustrate the varieties of one-celled animals found abundantly wherever there is water, from the ocean bottom to the moist tissues of plants and animals. Of these the radiolarians which form a siliceous or "glassy" skeletal structure of marvelous symmetry and complexity are particularly fine objects for displaying the technique of the glass blower who must fashion the multitude of minute spicules from plain glass rods and tubes. The models have been made by reference to the actual animals under the microscope. Natural colors have been imparted either by colored glass or by oil paint applied with the air brush. In this exhibit one may conveniently study the structure of those very minute animals which, for the most part, are too small to be visible to the eye, yet which play such an important rôle in human health and comfort.

The Birds of Eastern Canada, by Dr. P. A. Taverner, has appeared as Memoir 104 of the Geological Survey of Canada. The major portion of the book is occupied with systematic accounts and some natural history notes of the various species, illustrated with one hundred reproductions in color. In addition, the work contains a bibliography of ornithological literature, and a number of introductory chapters on geographical distribution, migration, and protection, and on various means of attracting birds about the house.

A NEW monthly magazine, *Discovery*, has appeared this year in England under the editorship of Dr. A. S. Russell, professor of chemistry in the University of Sheffield. *Discovery* aims to record in popular form the "advance made in the chief subjects in which investigations are being actively pursued," both in the sciences and the humanities, by authors who speak with authority in their respective fields.

"SAVE the Redwoods Day," February 27, was the occasion of a conference of the Save the Redwoods League, held in San Francisco in connection with the Pacific Automobile Show, at the Municipal Auditorium.

DR. G. CLYDE FISHER, associate curator of the department of public education, and Dr. F. E. Lutz, associate curator of invertebrate zoölogy, will represent the American Museum at the annual conference of the American Camp Directors' Association to be held in May at Greenkill Camp near Kingston, New York. Dr. Lutz will have charge of the insect work, and Dr. Fisher of birds. The work is done in conjunction with the Woodcraft League of America, whose president, Ernest Thompson Seton, will have charge of the camp woodcraft.

THE fascination of fishing, and of learning unknown facts, the charm of the sea, and of free life in the open are blended to an unusual degree in a recent book by Zane Grey, *Tales of Fishes.* The volume deals mostly with the pursuit by rod and line of the largest and gamest salt-water fishes, the tarpon, swordfish and tuna.

AN expedition to Jamaica, undertaken jointly by the department of mammalogy and the department of vertebrate palæontology of the American Museum, under the leadership of Mr. H. E. Anthony, associate curator of mammals, has returned with a great mass of material. The collections, which date back to the Pleistocene era, comprise many hundreds of pounds of bone-bearing breccia found in the caves of Jamaica.

THE death is announced from Argentine of Dr. Francisco P. Moreno, anthropologist, naturalist, explorer, and pioneer in the promotion of scientific institutions and research in that country. Dr. Moreno founded the Anthropological and Archæological Museum of Buenos Aires in 1877 and the La Plata Museum in 1889, and was director of the latter until 1907. He was well known in Europe, especially in connection with his voluminous labors on the Argentine-Chile boundary dispute on which he spent many years.

THE second annual meeting of the American Society of Mammalogists will be held in New York City, May 3–5, at the American Museum of Natural History.

The Brooklyn Museum Peruvian Littoral Expedition, which sailed last August for Peru under the leadership of Mr. Robert Cushman Murphy, curator of the department of natural science, has returned to New York. The expedition completed a comprehensive survey of the avifauna of the Peruvian Current and of the coastal islands. Many still and moving pictures were taken of the colonies of pelicans, cormorants, and other sea birds which nest on the islands.

The Carnegie Corporation of New York has given $5,000,000 to the National Academy of Sciences and the National Research Council for the construction of a suitable building and the endowment of the Council.

Dr. Burton E. Livingston, professor of plant physiology in Johns Hopkins University, has been elected permanent secretary of the American Association for the Advancement of Science to succeed Dr. L. O. Howard, now president of the Association.

The first number of the *Bulletin of the National Research Council* appeared in October and was devoted to a general discussion of the national importance of scientific and industrial research by Professor George Ellery Hale, honorary chairman, the Honorable Elihu Root, Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, and several notable representatives of large industries, members of the advisory committee of the Council. The *Bulletin* is to be devoted to illustrations of the possibilities of coöperative research and of the methods and successes in various branches of science and technology.

The progress of the British Museum (Natural History) since its removal to special buildings in South Kensington in 1882–83 is recorded in a letter to *Nature* by the director, Dr. S. F. Harmer. At the time of this change it is estimated that the number of specimens in the department of zoölogy was about 1,400,000. These have increased to 6,000,000 and there has been a proportionate increase in other departments. The Museum has also accomplished much in the way of exhibiting its collections for educational purposes in accordance with a change of view as to the public functions of museums in general. The evolution of animals, geological history, habitat groups, and many other exhibits of a general nature have been arranged for the public during the last quarter century.

Dr. J. Percy Moore, of the Federal Bureau of Fisheries, investigated last summer in the Palisades Interstate Park an important method of eliminating mosquitoes. Dr. Moore, while a member of a party representing the Bureau and the New York State College of Forestry which was studying the fish conditions of the park, demonstrated that pools and inlets, the entrances to which were obstructed to fish by the growth and accumulation of plants, harbor great numbers of mosquito larvæ. When the plants were cleared away and the shore line opened, the fish destroyed the greater number of the larvæ, as was proved by subsequent examination of the water and of the stomach contents of the fish.

At the request of Dr. Gustave Straubenmüller, associate superintendent of the public schools of New York City, the American Museum, through its department of education, has inaugurated a series of lectures for student-teachers. The New York Training School for Teachers at One Hundred and Twentieth Street has been made the lecture center upon the suggestion of the principal, Mr. Hugo Newman.

The lecture by Mr. William L. Finley on February 21, at the American Museum, was made doubly interesting by excellent pictures. Views of the ptarmigan, water ouzel, grebe, and chipmunk were particularly fine, and gave evidence of an unusual ability in the handling of wild life. The water ouzel was shown playing about the rocks and plunging into icy brooks. The grebe, also a brilliant performer under water, covered its eggs carefully with rushes to preserve them from crows, before going off to feed. A ptarmigan, a bird almost extinct in the United States, allowed Mr. Finley to stroke its back and raise it high enough from its nest to show the eggs. The chipmunk was an acrobat; he gave a "tight-rope performance" on a tent guy, and hauled up and opened paper parcels containing nuts which had been tied to it.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

MARCH–APRIL, 1920

VOLUME XX, NUMBER 2

NATURAL HISTORY

VOLUME XX CONTENTS FOR MARCH–APRIL NUMBER 2

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

Subscriptions should be addressed to the Secretary of the American Museum, 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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THE AMERICAN MUSEUM SERVES AS A LABORATORY, AS "THE COUNTRY," OR EVEN AS A DISTANT WILDERNESS FOR NEW YORK SCHOOL CHILDREN

GEORGE H. SHERWOOD

Curator of Public Education in the American Museum

Mr. Sherwood is a graduate of Brown University and came to the American Museum in November, 1901, as assistant curator of invertebrate zoölogy. In 1906 he was appointed curator of the department of public instruction (now officially designated "public education"), following the retirement of Professor Albert S. Bickmore. Mr. Sherwood at this time also assumed administrative duties as assistant treasurer (1906–10) and assistant secretary of the Museum (1906–) to which the greater part of his time is given. Under his direction, the present close relations with the public schools have been developed. The Museum has just published a history of its educational work, prepared by Mr. Sherwood, entitled *Free Nature Education.*

See "New Plans in Nature Extension Work," p. 173

NATURAL HISTORY

VOLUME XX MARCH-APRIL, 1920 NUMBER 2

Alaska Can Save the American Eagle

THE BIRD OF OUR NATIONAL HISTORY THREATENED WITH EXTINCTION

By WILLIAM T. HORNADAY

Director, New York Zoölogical Park since 1896, and an initial power in the promotion of preserves and laws for the conservation of wild life in America

THE American "Bird of Freedom," inseparably associated with the Stars and Stripes since the beginning of the American Republic, today is under attack, and its race will succumb to extermination unless relief arrives at once. And there can be only one adequate relief. The legislative body of Alaska must repeal its bounty law—for to put a price on the heads of the members of a species of wild life, as has been done on the bald eagle throughout Alaskan territory, is the one surest way to exterminate that species.

The soldier graves in France record the toll of the many Americans who lost their lives as they fought under the American flag and followed the lead of the American eagle in the great World War. Here in America for the period of the war millions of school children the country over have daily saluted the American flag. Have they been taught about the American Eagle? Perhaps in our devotion to the "Stars and Stripes," we have somewhat forgotten "Old Baldy," which our forefathers chose more than a century ago as the standard bearer of the nation, and which is immortalized in our literature and on our coinage. Its wild bold ranging of cliff and sky typified the liberty the American colonists sought and they adopted the great bird as the emblem of American freedom—yet through the act of Americans the living race of the eagle is today traveling the quick road to oblivion!

Two years ago the territorial government of Alaska was misled by stories of alleged "destruction of salmon and game" perpetrated by eagles, to enact a blanket law and offer a bounty of fifty cents a head for eagles, either the golden or white-headed species, throughout the territory. This was in opposition to the practice of the United States Department of Agriculture during the last twenty-five years. The policy is against paying bounties even on hawks, and this policy is based on the research and experience of more than half a century.

The bald eagle, however, is particularly a harmless bird in most localities. Living along river margins and the seacoast, it has small opportunity to feed upon the game animals of more wooded areas. Its favorite food is fish and in Alaska it feeds on the salmon which die on their spawning beds after spawning. As all salmon die in this way surely a share of them may be granted as the eagle's lawful prey.

Now it is entirely conceivable that in small areas here and there in America, eagles, or bear, and even such gentle creatures as bobolinks, doves, and rob-

THE AMERICAN EAGLE

The bald eagle (*Haliaetus leucocephalus*) is threatened with extinction in its last retreat, the Territory of Alaska. This highly conspicuous bird has always been handicapped in the struggle to maintain itself against the encroachments of man, despite its great strength, unequaled power of flight, and longevity. In Alaska the species has encountered such great hostility that a price is now on its head and unless the territorial legislature, or Congress, can be prevailed upon to afford protection, its days are numbered. The present situation is entirely the result of misinformation and prejudice, for the eagle feeds largely upon dead fish, especially seaward-bound salmon which after spawning die before they reach open water. Surely, if the public is adequately informed, it will not permit one state or territory to nullify the efforts of all the others to preserve from extinction one of the most picturesque representatives of our wild life and the emblem of the American nation. This illustration is from the Brooklyn Museum's bald-eagle group, destroyed by fire in 1914. The specimens were collected in Virginia by Mr. R. H. Rockwell

With appreciation of the courtesy of the Brooklyn Museum in allowing reproduction of this photograph of what was one of its most remarkable groups

ins,—even female deer, may become so numerous as to constitute nuisances, requiring abatement by systematic and carefully considered measures. For such cases New York, for instance, has an admirable wild-animal nuisance law —rarely invoked, however. The necessity to kill off a wild surplus in a given locality has long been conceded: but to sweep a whole province on an exterminatory basis—by a price on heads, open to every gunner—is quite a different matter.

We will admit that the mistake of granting a bounty on the eagle in Alaska was typical of our government which tries to be "all things to all men" and in so doing often burdens or bereaves the whole continent in order to facilitate the success of an insistent few in a limited locality—whether they be lumbermen, fishermen, or fur farmers. Locally in Alaska there has been reaction against the bounty on eagles and the law will eventually be repealed. In the last session of the territorial legislature, Senator D. A. Sutherland led a movement designed to do away with it, but was defeated. May Alaska waken so that the repeal will not come too late. When we know the very small total number of living eagles at best, the tale of 5060 slaughtered and paid for up to January 1, 1920, is to American ornithologists and wild life protectors, as well as to patriotic citizens of the country, distinctly disconcerting.

The Alaskan white-headed eagle is the largest and finest on the continent and everywhere outside of Alaska the species is steadily becoming very scarce. In the Eastern States only a few remain in place of the many that were here even thirty years ago. Not enough mature birds are caught to keep the zoos supplied. The eagle is a slow breeder, and the population of the species is continually diminishing. Once the Palisades of the Hudson knew the great bird well, but ere long the slow and majestic sweep of its broad pinions will be looked for there in vain.

Civilization is against the eagle. It is robbing it of its lawful prey, and giving it nothing in return. Far too much has this bird of our national history been flouted and neglected. We must honor it more, protect it better, or see it wholly disappear from the land of our fathers.

The bald eagle and heraldic symbols of the Great Seal of the United States after the new cutting made by the direction of President Roosevelt in 1903.—The original design was drawn by Will Barton, A. M., and adopted in 1782. "The escutcheon," explained Barton, "is borne on the breast of the American eagle, without any other support, to denote that the United States of America ought to rely on their own virtues"

The Schoolboy and His Forest[1]

By FRANK H. WOOD

The University of the State of New York, Albany, New York

THESE are two very suggestive and illuminating words—schoolboy and forest, which unloose the doors of our memory and our imagination. To what extent of time, place, and circumstance do they not take us! As we meditate on each in its bearing upon our own personal experience, how readily the past becomes present! How vivid seem the pictures that have been long hidden away in the inner recesses of the mind!

In considering the first cardinal word of our subject, in these days of "equal rights and equal opportunities" —and let us not forget to add, also, multiplied responsibilities—we must turn entirely aside from the lexicographer, and think of the boy as a human being, an animal of the genus *Homo*, between the ages of five and twenty-one.

This is the entire period that bridges over that critical time between childhood and maturity, that begins in weakness, immaturity, and dependence, and ends in strength, vigor, and self-reliance. It is the habit-forming period, the period of easy and lasting impression, the time when the seeds of good or ill may be most readily implanted and will take deepest root. It is the time when the senses are most alert, when the feelings are most easily aroused and the sensibilities are most readily appealed to, when the intellect is most susceptible of development and the will of training. It is the time when the imagination is most active, can be most readily aroused and easily cultivated. It is a time indeed to see visions and to dream dreams:

"There was a time when meadow, grove, and stream,
The earth, and every common sight,
To me did seem
Apparelled in celestial light,
The glory and the freshness of a dream."

The use that is made of this period will inevitably exert a wide influence on the industries and occupations of life, on the trades and the professions. It will affect the character of the home, the appearance of the landscape; it will enter largely into the lives of the people, into the nature of their dealings, the character of their relations; yes, far more, upon it will ultimately depend the destiny of the nation.

If we turn to the encyclopedia or the dictionary for the meaning of forest, the second key word of our subject, we find it explained in about these words: "a tract of land or of country covered with trees"; and then, if we look farther, we find that a tree is "a woody plant of considerable size with a single trunk." There is indeed very little to satisfy us in such definitions.

If we should turn to the woodman or to the manufacturer or dealer in forest products, he would define the word in terms of feet of lumber, tons of pulp, or dollars of profit. The naturalist would think of the forest as a shelter or home for the birds and wild beasts; the artist as that which gives form, color, and setting to the landscape, and satisfies ideals of the beautiful and the picturesque; and the lover of nature would regard it as a sacred retreat, a shrine for rest, quiet, and communion.

[1] Extracts from address presented by Dr. Wood on April 12, 1920, at the First Annual Forest Week meetings of the New York State College of Forestry, Syracuse University.

The forest should convey to the mind and heart all of these ideas and meanings—and more. Before attempting to understand what the forest means, one must know it from actual contact and personal knowledge: one must also see it through the eyes of others, past and present; one should draw upon all sources that I have already mentioned, and also upon the wealth of history and the teachings of tradition, poetry, and song.

Away back in early sacred history, in the Levitical law, we find Moses, the lawgiver, forbidding the destruction of trees in laying siege to cities. "Thou shalt not destroy the trees, for the tree of the field is man's life." In his majestic "Forest Hymn," Bryant says:

"The groves were God's first temples, ere man learned
To hew the shaft and lay the architrave,
And spread the roof above them, ere he framed
The lofty vault, to gather and roll back
The sound of anthems; in the darkling wood,
Amidst the cool and silence, he knelt down,
And offered to the Mightiest solemn thanks
And supplication."

And notwithstanding the very considerable modern neglect and desecration of forests, we still may know that all through the ages, reaching down even to the present moment, trees and forests have been sacred to worship.

Some four hundred years ago, Edmund Waller in his beautiful poem "On St. James's Park" sang thus:

"In such green palaces the first kings reign'd,
Slept in their shades, and Angels entertain'd;
With such old counsellors they did advise,
And, by frequenting sacred groves, grew wise."

The forest is a unique place for rest and recreation. How many wearied with the tasks of life, with the cares and strifes of daily action are wont to look to the forest for refreshment—as Edwin Markham writes:

"Give me green rafters and the quiet hills
Where peace will mix a philter for my ills—
Rafters of cedar and of sycamore,
Where I can stretch out on the sacred floor,
And see them peer—the softly stepping shapes—
By the still pool where hang the tart wild grapes.

There on the hills of summer let me lie
On the cool grass in friendship with the sky.
Let me lie there in love with earth and sun,
And wonder up at the light-foot winds that run,
Stirring the delicate edges of the trees,
And shaking down a music of the seas."

Edward Roland Sill in "Forest Home" very tenderly puts into verse this longing for the forest rest, at once so human and yet so exalted.

"Oh, Forest-Mother, I have stayed,
Too long away from thee;
Let me come home for these few hours
That from the world are free."

'Twere sweet, I know, to stay; but so
'Twere sweetest to depart,
Thy cool, still hand upon my face,
Thy silence in my heart."

To one of experience and imagination, with acquaintance with the forest, these references and quotations bring out something of the meaning of the word, but to define or describe it, to convey its real meaning in words would be a hopeless and impossible task. The man who knows the meaning of the word is in touch with the forest in its various and varying moods, he feels them, he senses them by day and by night, in summer and in winter, in sunshine and in storm. He comes to know forest values also—healthful and recreational, æsthetic and spiritual, as well as commercial and utilitarian.

The schoolboy's forest then must be the forest in which all of these ideals have been implanted and inculcated. They must be felt in their essence and not defined and formalized by words.

To the youth as to the people of antiquity, the forest is the natural realm of legends, folk lore, myths, and fables. It is peopled with sprites and fairies, tree gods, and divinities; it is the realm of the supernatural, in which is found condensed in figurative and mythical language much of the riches of race experience and the spiritual wealth of past ages.

In one of his lectures on "Race Power in Literature," delivered before the Lowell Institute in Boston in 1903, Dr. George Edward Woodberry calls mythology one of the "three tongues of the imagination," the other two being chivalry and the Scriptures; and then he pictures their importance in this strongly significant language:

"It is far more important to know them than to learn French or German, or Latin or Italian, or Greek; they are three branches of that universal language which, though vainly sought on the lips of men, is found in their minds and hearts. To omit these in education is to deprive youth of its inheritance. It is like destroying a long developed organ of the body, like putting out the eye or silencing the nerves of hearing. Nor is it enough to look them up in encyclopedias and notes and so obtain a piecemeal information; one must grow familiar with these forms of beauty, forms of honor, forms of richness, have something of the same sense of their reality as that felt by Homer and Virgil, by the singer of 'Roland' and the chronicler of 'Mort d'Arthur,' by St. Augustine, and St. Thomas."

Thus it is that the schoolboy's forest must first of all be a forest of myths and legends; and the riches of the past must be freely drawn upon to provide an abundance of the best which has been handed down from father to son, from generation to generation, and age to age, through all the centuries of the past.

After the age of myths and legends and in part contemporary with it, there follows another period in the boy's life, the spirit of which is depicted in the opening lines of the old familiar song:

"Oh the sports of childhood!
Roaming through the wildwood"

and in the words of Wordsworth,

"And then my heart with pleasure fills,
And dances with the daffodils."

It is the period of growth and development when the forest becomes the natural recreation field for youth, nature's playground, the most fitting place for walks, tramps, sports, and games, the place to hunt wild flowers, to search acquaintance with insects and animals, and to become familiar with all forms and kinds of plant life.

Then it is that the schoolboy should come into intimate association and direct communion with the trees and forests in their manifold forms, shapes, and expressions. This is the time of all times for him to acquire tree knowledge and forest lore by observation and objective study.

It is the duty and privilege of the school to make the most of all favorable opportunities to further and encourage this sort of training in tactful ways, by appropriate means, at opportune times, and to direct and supervise it, bearing in mind that that which appears accidental and incidental in instruction often proves the most serviceable, beneficial, and enduring.

Unfortunate is it indeed when, through man's negligence, ignorance, wastefulness, and greed in regard to the nation's forests, the boy is deprived of free association with them; and also unfortunate is the boy who, as Cowper says,

"Immured in cities, still retains
His inborn, indistinguishable thirst,
Of rural scenes, compensating his loss
By supplemental shifts, the best he may.
The most unfurnished with the means of life
And they that never pass their brick-wall bounds
To range the fields, and treat their lungs with air,
Yet feel the burning instinct."

Later on in the life of a youth there comes a stage of progress and development when instruction may assume a formal character, when books and periodicals may be drawn upon more freely, when the teacher and the boy can come into sympathetic understanding without the living medium of the trees to make the lessons interesting and helpful.

Then is a time to give the schoolboy formal lessons in plant life and plant growth, to give instruction in the care of trees, their uses, the commercial products that come from them, the need of forest protection, and in simplified form the aims and some of the principles of forestry.

This is a stage when can be used effectively such an incident as narrated by Sir Walter Scott in his tale of a Highland laird, who while on his deathbed said to his son, "Jock, when ye hae naething else to do, ye may be aye sticking in a tree; it will be growing, Jock, when ye're sleeping." Pupils should be taught about noted forests and forest preserves, past and present, should learn names, location, and incidents connected with famous individual trees in history, especially of our own country, such as the Charter Oak and the Hartford Elm.

There comes a time also when it is fitting to consider in somewhat formal manner trees and woods from the æsthetic standpoint, to study and search out the elements of beauty in them, to learn to appreciate their shapeliness, to make a study of the individual tree as well as the tree mass, to select the finest illustrations of beautiful trees to be found in the neighborhood, to learn to distinguish at sight trees of different kinds by their special characteristics.

The schoolboy needs all of the help and encouragement from outside sources that he can receive in order to make his forest what it ought to be.

And what is the Schoolboy's Forest? It is the forest that is implanted during the boy's school days when the conditions are so favorable, when the soil is responsive to culture—the forest that grows with his growth and develops with his development. It is the forest that can be visualized only in his manhood. It is to be seen then in his home, along the roadsides and in the public parks of his home city, and in the forest preserves of his home state. In a word, the Schoolboy's Forest is one the seeds of which are sown in the mind and heart of the boy and blossom into full fruitage in the life of the man.

John Muir in Yosemite

By WILLIAM FREDERIC BADÈ[1]

IMAGINE the Rip Van Winkle bewilderment of an old Yosemite pioneer like James C. Lamon, if he could wake from his forty-five years' sleep in the little graveyard near the mouth of Indian Cañon, and come back to his old haunts! During the sixties and seventies the sunny quiet of the valley was hardly broken by the deep monotone of the waterfalls whose music, even for a newcomer, seemed part of the great, sheer-walled silence. But now, at the height of the tourist season, great camps and hotels, crowded with thousands of visitors, shed unwonted noise and electric glare among the astonished groves and their furred and feathered inhabitants. Old-time trails, grown into highways, resound with the horns of innumerable automobiles, and a railroad delivers its human freight of recreation seekers at a terminal on the edge of the park, twelve miles from the valley.

From the end of the sixties until well into the seventies John Muir also made his home in Yosemite, but he lived far enough beyond these decades to see the rising human tide of pleasure seekers set Yosemite-ward, and rejoiced in the sight. He used to say that he was moved to write about the beauty and sublimity of the valley only because he wished to incite people to come and see it for themselves. And now that they are coming in ever-increasing numbers they in turn are beginning to ask questions about the man who described it so alluringly. Where, in the valley, did he live? What was his occupation while there, and how did he go about his studies?

Although in the adventurous life of John Muir fact often was more wonderful than fiction, inquirers are sometimes obliged to content themselves with the latter. Perhaps it is natural that so picturesque a personality should become a magnet for legends. In any case, although he has been gone only five years, one legend is already current in Yosemite Valley. It concerns the place of his former habitation. There is little doubt that it owes its origin to the desire of local cicerones to gratify the desire of visitors who wish to see some particular spot that has associations with John Muir.

In a secluded, umbrageous tangle of alders and azaleas, on the spit of land formed by the confluence of Tenaya Creek with the Merced, stands what at first glance looks like the remnants of a log cabin. Examination reveals the fact that there never had been a floor or windows; that it was never more than partly roofed and too low for a man to stand comfortably erect, while the opening which should serve as a door is only three feet high. It is all that remains of Lamon's goat or sheep corral. But the myth-making faculty of the local guide and antiquary has glorified it as "Muir's Lost Cabin," and as such it has been and is being pointed out to great numbers of eager sightseers. The adjective "lost" is an important adjunct; it stimulates curiosity by hinting at mystery.

But there is no mystery about the two cabins which John Muir erected for himself in Yosemite. The places where they stood are known, although not a vestige of the original structures remains. The first he erected late in 1869 near the lower Yosemite Falls.

[1] Professor Badè has recently been made president of the Sierra Club. He is editor of the *Sierra Club Bulletin*, and professor of Old Testament literature and Semitic languages at the Pacific School of Religion, Berkeley, California, and is well known for his work as a conservationist. He is president of the California Associated Societies for the Conservation of Wild Life.

AT THE ENTRANCE OF YOSEMITE VALLEY

"To an observer . . . . in the midst of such scenery, ... the day seems endless, the sun stands still. Much faithless fuss is made over the passage in the Bible telling of the standing still of the sun for Joshua. Here you may learn that the miracle occurs for every devout mountaineer, for everybody doing anything worth doing, seeing anything worth seeing. One day is as a thousand years, a thousand years as one day, and while yet in the flesh we enjoy immortality."—From John Muir's *Our National Parks*, 1901 (p. 102).

Muir expressed the same idea in one of his last conversations with Professor Badè, and the latter quotes it in his "Introduction" to Muir's *Story of My Boyhood and Youth*: "Longest is the life that contains the largest amount of time-effacing enjoyment—of work that is a steady delight. Such a life may really comprise an eternity upon earth"

Courtesy of Brown Brothers

It was from such points of vantage that Muir studied Yosemite. Especially was it his delight to reach some high ridge during or immediately after a heavy winter storm, in order to see the sunset over a wide extent of snow-covered mountain and forest, to study the wind-blown snow clouds as they swirled from peak to peak, and snow avalanches as they swept down the cañons. Just once was he forced to ride on such an avalanche. He had spent the whole day, waist deep in snow, climbing laboriously up the cañon. He had hoped to reach the ridge 3000 feet above before sunset, but when still a few hundred feet of his goal, he was suddenly swished, in the space of about a minute, down to the bottom of the cañon —fortunately on top instead of buried under the snow. He always spoke of the experience as the most "spiritual" of all his travels, a "flight in a milky way of snow flowers" (*Our National Parks*, p. 276)

The only photograph ever taken, so far as known, of John Muir's cabin, his first home in Yosemite.—Unfortunately the picture shows the roof only, the walls being hidden by tall ferns and second growths. The cabin was built of sugar-pine "shakes," and through one corner flowed and sang a stream of rapid water diverted from Yosemite Creek. Nothing remains of Muir's cabin today, or of his "hang-nest," a retreat near his cabin, built high and reached by a ladder. Emerson visited this "hang-nest" and looked with Muir through its two skylights,—one giving a view of South Dome, the opposite, of upper Yosemite Falls. (*Photograph by the late George Fiske*)

To Muir, South Dome, or Half Dome as it is also called (at the right), which rises from woods and meadows to a height of 4750 feet above the valley, had no sense of the dead stone about it; instead, it gave him an impression of steadfastness in serene strength—like a god

The quiet waters of Mirror Lake.—This and the many other beauties of Yosemite, known to so few in the early days of John Muir, are now seen and enjoyed by thousands of American tourists yearly. There is something worth while to be discovered in Yosemite all the year round

This cabin was built of sugar-pine shakes and is reputed to have been the handsomest building in the valley. By means of a ditch he made a part of the beaten waters of Yosemite Creek flow through a corner of the cabin, with just enough current to make it "sing and warble in low sweet tones" as it bickered by his bed.

He was employed at this time by J. M. Hutchings to construct a sawmill —not, however, for the cutting of living trees. A few years earlier a severe windstorm, sweeping through the valley, had thrown down a large number of cedars and pines. These, by express permission of the commissioners, Mr. Hutchings was allowed to convert into building material. It seems important to state these facts since during the Hetch-Hetchy controversy some of Muir's opponents falsely charged that he had erected a sawmill in Yosemite Valley in order to denude it of its trees. The very site of the old sawmill is still surrounded by pines and incense cedars of great age.

At one end of the mill he had built for himself a unique retreat, attached to the gable, which people called "the hang-nest." A kind of chicken-ladder led up to this sky parlor, and in writing to his sister he humorously remarked, "Fortunately the only people I dislike are afraid to enter it." Ralph Waldo Emerson climbed into it to look over his sketches and botanical collection and came away declaring fervently, "Muir is more wonderful than Thoreau." We may imagine with what enthusiasm Muir showed Emerson the sights to be seen from his two skylights on opposite sides of the roof. One opening commanded a view of South Dome, and the corresponding one on the other side made a frame for a living picture of the upper Yosemite Falls. "Here," we might have heard him say, "nature offers brimming cups in endless variety, served in a grand hall, the sky its ceiling, the mountains its walls, decorated with glorious paintings and enlivened with bands of music ever playing."

This hang-nest and his sugar-pine cabin were the places which he called his first home in Yosemite. There, as the letter of a reminiscent friend reveals, he might be found under the lamp in the evening reading the writings of Alexander von Humboldt and Sir Charles Lyell, and the latest botanical works on trees. Through his numerous friends the most important new books of a literary or scientific nature speedily found their way to his cabin where the long winter evenings, especially, were devoted to a wide range of reading and research.

In the summer of 1871 he left the employ of J. M. Hutchings, and in December he wrote from his old haunts along the Tuolumne near Lagrange that Mr. Hutchings required the sugar-pine cabin for his sister, and that in consequence he was "homeless again." "I expected to pass the winter there writing, sketching, etc., and in making exploratory raids back over the mountains in the snow. But Mr. Hutchings' 'jumping' my nest, after expressly promising to keep it for me, has broken my pleasant lot of plans, and I am at work making new ones."

In January, 1872, he was back in the valley, "gloriously snow-bound." He had taken up his quarters at Black's Hotel which stood not far from the massive pedestal of Sentinel Rock. It was during the winter season of this year that two natural phenomena occurred which deeply impressed Mr. Muir. The one was a great flood-storm, the other a violent earthquake. Of the former he wrote to his sister Sarah, "We have had the grandest flood that has occurred in three years. More than three hundred falls, averaging near three thousand feet in height, sang together in glorious jubilee, besides a countless company of silvery arteries gleaming everywhere. A per-

Courtesy of the Sierra Club Bulletin

THE MERCED, OR "RIVER OF MERCY," THROUGH THE VALLEY

The Merced flows through Yosemite (4000 feet elevation), and the walls of the valley at right and left rise 5000, and 6000, and 7000 feet in living rock sculptures. Here have stood for many thousands of years the majestic cliffs, domes, and spires, unaltered under the attacks of avalanche and storm. Muir gloried in the rain storms of the high Sierras, which he described as extravagant in their grandeur: the thunder speaks with concentrated energy as though an entire mountain were being shattered at every stroke; the ground of mountain-side and valley everywhere becomes covered with a transparent sheet of flowing water, and water booms and shouts down the ravines. And who but Muir would have said, "Happy the showers that fall on so fair a wilderness as Yosemite"


Yosemite trees under the snows of winter time

fect storm of waterfalls, the smallest with a voice that was hearable at a distance of several miles." The same letter contains a hint of his literary activity at this time,—"With this mail," he writes, "I send thirty letters, and the writing of these, together with my glacial studies, has kept me busy."

The earthquake occurred March 26, 1872. "At half-past two o'clock of a moonlit morning," Muir wrote, "I was awakened by a tremendous earthquake, and though I had never before enjoyed a storm of this sort, the thrilling motion could not be mistaken, and I ran out of my cabin, both glad and frightened, shouting, 'A noble earthquake! A noble earthquake!' feeling sure I was going to learn something. The shocks were so violent and varied, and succeeded one another so closely, that I had to balance myself carefully in walking as if on the deck of a ship among waves, and it seemed impossible that the high cliffs of the valley could escape being shattered. In particular, I feared that the sheer-fronted Sentinel Rock, towering above my cabin, would be shaken down, and I took shelter back of a large yellow pine hoping that it might protect me from at least the smaller outbounding bowlders. For a minute or two the shocks became more and more violent—flashing horizontal thrusts mixed with a few twists and battering, explosive, upheaving jolts,—as if nature were wrecking her Yosemite temple, and getting ready to build a better one." It was on this occasion that he saw Eagle Rock on the south wall give way and fall into the valley with a tremendous roar. "I saw it falling," writes Muir, "in thousands of the great bowlders I had so long been studying, pouring to the valley floor in a free curve luminous from friction, making a terribly sublime spectacle—an arc of glowing passionate fire, fifteen hundred feet span, as true in form and as serene in beauty as a rainbow in the midst of the stupendous roaring rock-storm." He was thrilled by the phenomenon for he realized that by a fortunate chance he was enabled to witness the formation of a mountain talus, a process about which he had long been speculating.

Before the great bowlders had fairly come to rest he was upon the new-born talus, listening to the grating, groaning noises with which the rocks were gradually settling into their places. His scientific interest in the phenomenon made him so attentive to even its slightest effects that all fear was banished and he astounded his terrified fellow residents of Yosemite with his enthusiastic recital of his observations. They were ready to flee to the lowlands, leaving the keys of their premises in his hands, while he prepared to resume his glacial studies, armed with fresh clues to the origin of cañon taluses.

It was during the spring of this same year that he erected a log cabin for himself in a clump of cornus bushes, near the Royal Arches, on the banks of the Merced. The precise locality is to be sought at the point where the Merced approaches closest to the Royal Arches, and in a bold curve swings southward again across the valley. In the same neighborhood Lamon had also built his winter cabin. During the cold season of the year, when the south side of the valley is wrapped in the frosty shadows of its high walls, the sun shines obliquely against the talus slopes of the north side and generates a grateful warmth. Here, then, was Muir's second home in Yosemite Valley—one, however, that he seems to have occupied very little after 1874. The survival of Lamon's old corral in the immediate neighborhood has led to its identification with this last of Muir's cabins.

A subject that more than any other engaged Muir's attention during his residence in Yosemite was the question of the valley's origin. In 1870 we al-

Wide, shining, and rainbow waters of Vernal Falls

North Dome and the Merced through the valley

ready find him an advocate of the glacial erosion theory. To him, indeed, belongs the credit of having been the first to set forth this theory in a carefully reasoned form, supported by a mass of detailed observation. The paper of William Phipps Blake before the Paris Academy of Sciences in 1867 was based on hasty and inadequate field study. True, Clarence King as early as 1864 observed evidence of glaciation in the valley, but he continued to believe, in common with his chief of the California Geological Survey, Josiah D. Whitney, that the valley owed its origin to a great cataclysm. In any case he did not publish his glacial observations until his *Mountaineering in the Sierra Nevada* appeared in the spring of 1872. Then, in the chapter entitled "Around Yosemite Walls," he noted that one viewing the valley in its autumnal aspects "has crowded on him the geological record of mountain work, of granite plateau suddenly rent asunder, of the slow, imperfect manner in which nature has vainly striven to smooth her rough work and bury the ruins with thousands of years' accumulation of soil and débris."

Professor Whitney maintained that Yosemite Valley had been formed by block-faulting. ". . . the bottom of the valley sank down to an unknown depth, owing to its support being withdrawn from underneath," wrote Whitney. ". . . there is no reason to suppose . . . ," he asserted, "that glaciers have ever occupied the valley or any portion of it . . . A more absurd theory was never advanced than that by which it was sought to ascribe to glaciers the sawing out of these vertical walls and the rounding of the domes." Even in the higher regions outside of Yosemite he found no evidence of ice erosion, for, according to him, "Most of the great cañons and valleys of the Sierra Nevada have resulted from aqueous denudation."

"Based on entire ignorance of the whole subject," was the pungent and dogmatic fashion in which he dismissed the whole glacial erosion theory from his mind. Let me remind the reader that the man who expressed himself in this positive manner was chief of the California Geological Survey, and the only scientific man of acknowledged standing who up to that time had reached so decisive a judgment upon the facts. Besides, his conclusions were set forth in a volume "published by authority of the California Legislature." It required considerable courage, knowledge, and interpretative ability to enter the lists against such an antagonist.

But Muir accepted the challenge. Whitney's views, quoted above, as set forth in his *Yosemite Guide-Book,* probably became known to Muir in 1869, after his first summer in the Sierra. He at once recognized them as contrary to his understanding of the facts, but he took time to make a more careful geological study of the whole Yosemite region. All the time he could snatch from his occupation as sawmill operator and guide was employed in field study and exploration. Sundays, in particular, were devoted to what he calls "Sabbath raids among the mountains." The intensity of his application to his task and the progress of his studies are interestingly told in a letter of September 8, 1871, to his friend, Mrs. Ezra S. Carr.

"You know," he writes, "that for the last three years I have been ploddingly making observations about this valley and the high mountain region to the east of it, drifting broodingly about and taking in every natural lesson that I was fitted to absorb. In particular the great valley has always kept a place in my mind. What tools did He use? How did He apply them and when? I considered the sky above it and all of its opening cañons, and studied the forces that came in by every door that

Overhanging Rock giving view of Yosemite Falls

Courtesy of W. L. Huber

Looking eastward from the summit of Mount Hoffmann, Mount Dana on the skyline.—Muir visited Mount Hoffmann (11,000 feet elevation, about seven miles north of Yosemite Falls) during his first summer in the Sierra. In a volume dedicated to the Sierra Club of California he tells of this visit and the ambition that came to him then to understand better the "glorious landscape." In 1871 he camped one night on the summit of Mount Hoffmann with James Cross, of Oxford, England, and a Mr. Maxwell, of San Francisco. Beyond the summit this photograph shows a portion of the Tuolumne Meadows, the loveliest Alpine valley of the Sierra Nevada. Muir's glacial studies centered in and about this valley for several years

I saw standing open, but I could get no light. Then I said: 'You are attempting what is not possible for you to accomplish. Yosemite is the *end* of a grand chapter; if you would learn to read it, go commence at the beginning.' Then I went above to the alphabet valleys of the summits, comparing cañon with cañon, with all their varieties of rock-structure and cleavage and the comparative size and slope of the glaciers and waters which they contained; also the grand congregations of rock-creations were present to me, and I studied their forms and sculpture. I soon had a key to every Yosemite rock and perpendicular and sloping wall. The grandeur of these forces and their glorious results overpower me and inhabit my whole being. Waking or sleeping, I have no rest. In dreams I read blurred sheets of glacial writing, or follow lines of cleavage, or struggle with the difficulties of some extraordinary rock-form. Now it is clear that woe is me if I do not drown this tendency towards nervous prostration by constant labor in working up the details of this whole question. I have been down from the upper rocks only three days and am hungry for exercise already.

"Professor [John Daniel] Runkle, president of the Boston Institute of Technology, was here last week, and I preached my glacial theory to him for five days, taking him into the cañon of the valley and up among the grand glacier wombs and pathways of the summit. He was fully convinced of the truth of my readings and urged me to write out the glacial system of Yosemite and its tributaries for the Boston Academy of Science. I told him that I meant to write my thoughts for my own use and that I would send him the manuscript, and if he and his wise scientific brothers thought it of sufficient interest they might publish it.

"He is going to send me some instruments, and I mean to go over all the glacier basins carefully, working until driven down by the snow. In winter I can make my drawings and maps and write out notes. So you see that for a year or two I will be very busy. . . . Some of my friends are badgering me to write for some of the magazines, and I am almost tempted to try it, only I am afraid that this would distract my mind from my work more than the distasteful and depressing labor of the mill or of guiding. What do you think about it?

"Suppose I should give some of the journals my first thoughts about this glacier work as I go along and afterwards gather them and press them for the Boston wise; or will it be better to hold my wheesht and say it all at a breath?" Fortunately he decided not to hold his "wheesht"[1] but wrote out his "first thoughts" which appeared in the New York *Tribune,* December 5, 1871. In addition to Mrs. Carr, he also furnished, during the preceding summer, information about his discoveries to Clinton L. Merriam and J. D. Runkle. The latter, it seems, turned over the letters to his colleague, Samuel Kneeland, who made a use of them which Muir did not wholly approve, for in October, 1872, he wrote to a friend, "Professor Kneeland . . . gathered some letters I sent to Runkle and that *Tribune* letter, and hashed them into a compost called a paper for the Boston Historical Society, and gave me credit for all of the smaller sayings and doings and stole the broadest truth to himself."

Professor Kneeland, however, made some amends in the revised edition of his book, *The Wonders of Yosemite Valley* (1872) in which he referred to Muir as "the presiding genius of the valley, the high priest of this temple of nature," and pointed out justly that what others had seen on a limited scale, "Muir has examined on a very large scale, having traversed the upper Sierra in all directions, and ascertained the existence of a glacier system . . . whose size and direction had previously been rather guessed at than determined."

Courtesy of W. L. Huber
The needle on the west face of Cathedral Peak, Yosemite National Park

About this time Muir came into friendly relation with several scientific men of his time, foremost among them being Asa Gray, John Torrey, and Louis Agassiz. Agassiz was then the world's leading authority on the subject of glaciers. When Mrs. Carr (see page 133) showed him the "glacial letters" of her Yosemite correspondent, he became enthusiastic and declared that Muir's knowledge of glaciation exceeded that of any one whom he knew.

For two more years Muir continued

[1] A Scotch word for silence.

Cathedral Spires.—The spires and domes of Yosemite were carved out during the centuries they lay in darkness under the moving, crushing ice of glaciers. The preglacial landscape was destroyed; Muir delights in emphasizing that the destruction was creation. Just where the glaciers "crushed most destructively" are the most beauty and warm life today,—and even today under other forces, fast or slow, Yosemite's domes and spires are vanishing away

his glacial studies in and about Yosemite and then published his results, in 1874, in a series of seven remarkable articles in the *Overland Monthly.* They were illustrated with line drawings and have remained the most detailed and comprehensive studies[1] of the glaciation of the Sierra Nevada published thus far. It was unfortunate that they were not immediately gathered into the form of a book so as to be easily accessible to subsequent investigators. But the Mount Shasta region, Nevada, Utah, and Alaska soon began to absorb his interest, and he never managed to revise and prepare them for book publication.

During these studious Yosemite years, however, he learned to regard the surface of the earth almost as a living organism, and he was ever keenly interested to trace individual features of the earth's topography through progressive modifications of form and aspect to the point where the cycle of evolution might be said to have run its course. "Nature," he said, "is ever at work building and pulling down, creating and destroying, keeping everything whirling and flowing, allowing no rest but in rhythmical motion, chasing everything in endless song from one beautiful form into another." So impressed was one great geologist with Muir's vivid sense of this tendency to change that he felt sure, to use his words, "a popular physical geography by John Muir would usurp the place of the novel in the public library."

[1] They are now in process of republication in the *Sierra Club Bulletin.*

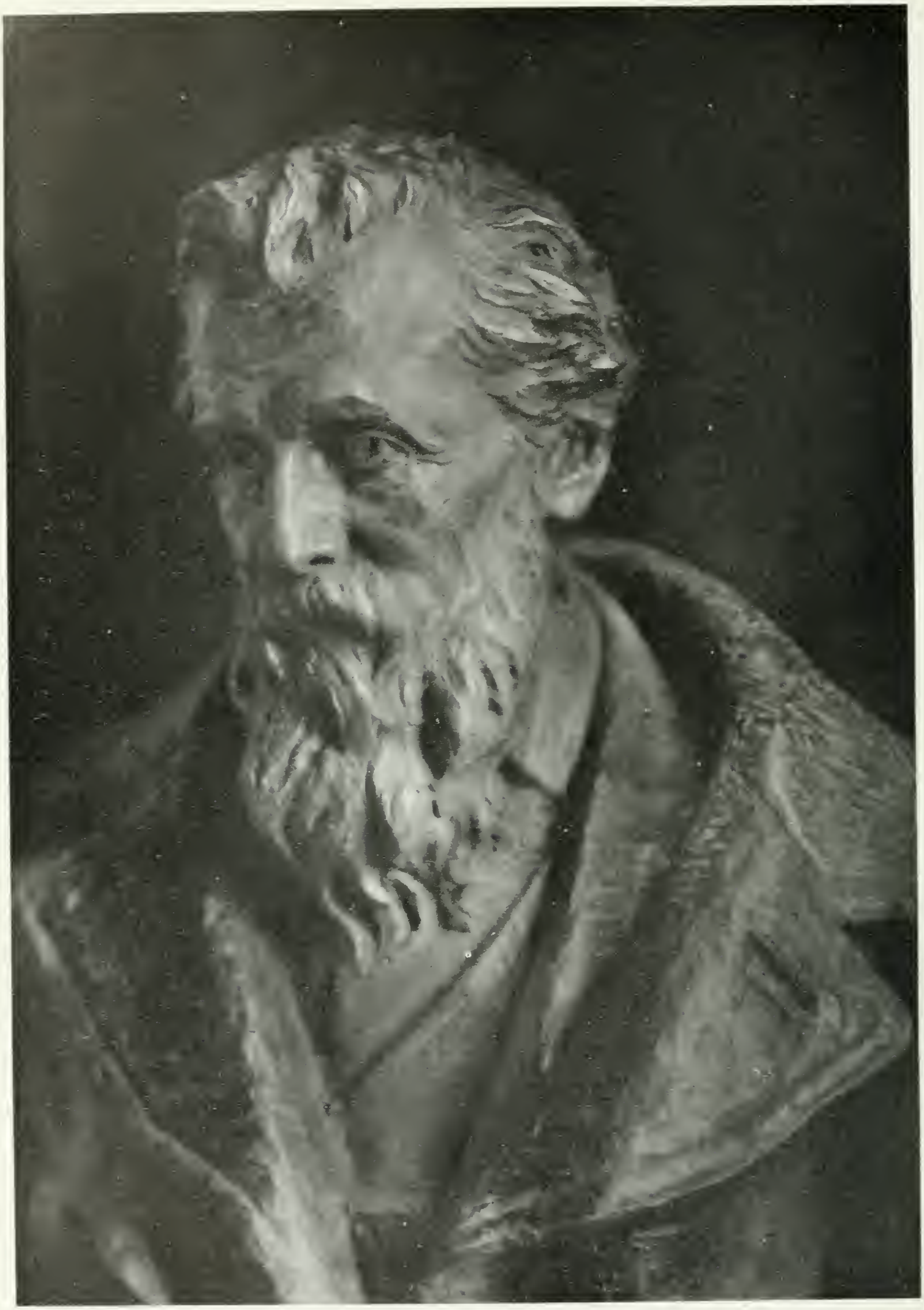
GLACIER-SCULPTURED SENTINEL ROCK OF YOSEMITE VALLEY

Courtesy of Underwood and Underwood

UPPER AND LOWER YOSEMITE FALLS

The booming, reverberating thunder of Yosemite Falls can be heard five or six miles away; it fills the valley, yet not until we reach Sentinel Rock do we see the whole half mile of falling water. Yosemite Falls are near the middle of Yosemite Valley, which is the heart of Yosemite National Park

EL CAPITAN'S IMPOSING FRONT OF GRANITE, ABOVE THE "RIVER OF MERCY"



JOHN MUIR

From a bust in bronze by Miss Malvina C. Hoffman, sculptor, which has recently been placed in the woods and forestry hall of the American Museum

Perhaps we cannot do better than to conclude this sketch with two paragraphs from his notebook of 1871. He had passed a beautiful September day in Yosemite Creek basin, tracing the pathway of an ancient glacier, and describing its gradual death where two freshly polished domes were reflected in two new-born moraine lakes. There night had overtaken him, and according to his custom he sought repose under the stars, but not before he had paid the following tribute to the beauty of his surroundings:

"How softly comes night to the mountains! Shadows grow upon all the landscape; only the Hoffmann Peaks are open to the sun. Down in this hollow it is twilight, and my two domes, more impressive than in broad day, seem to approach me. They are not vast and over-spiritual, like Yosemite Tissiack, but comprehensive and companionable, and susceptible of human affinities. The darkness grows, and all their finer sculpture dims. Now the great arches and deep curves sink also, and the whole structure is massed in black against the starry sky.

"I have set fire to two pine logs, and the neighboring trees are coming to my charmed circle of light: the two-leaved pine, with sprays and tassels innumerable, the silver fir, with the magnificent fronded whorls of shining boughs, and the graceful nodding spruce, dripping with cones, and seeming yet more spiritual in this camp-fire light. Grandly do my logs give back their light, slow gleaned from suns of a hundred summers, garnered beautifully away in dotted cells and in beads of amber gum; and, together with this outgush of light, seem to flow all the other riches of their life, and their living companions are looking down as if to witness their perfect and beautiful death. But I am weary and must rest. Good-night to my two logs and two lakes, and to my two domes high and black on the sky, with a cluster of stars between."

Sketch of a live oak (not heretofore reproduced) which grew near Muir's Yosemite cabin. To try to draw the trees and rocks of the high Sierras was his natural instinct. He spent many days sketching on North Dome—"perched like a fly," he said, on the granite surface—from which nearly all the valley is visible. "I would fain draw everything in sight. But little can I do beyond mere outlines—readable only to myself. Whether these picture-sheets are to vanish like fallen leaves or go to friends like letters, matters not much; for little can they tell to those who have not themselves seen such wildness, and like a language have learned it. No pain here, no dull empty hours, no fear of the past, no fear of the future . . . . no personal hope or experience has room to be."—From *My First Summer in the Sierra*. (The drawing is used through the courtesy of Mrs. Emily Pelton Wilson, of Pasadena, to whom Muir sent it in the seventies)

"The Manhattan Medical School"

Only a dream today, but its achievement would be an honor to the City and a benefit to the medical culture of the world

By GRAHAM LUSK

Professor of Physiology, Cornell University Medical College, and Scientific Director of Russell Sage Institute of Pathology

THE war in Europe led to a great transfer of the world's wealth to America. For months before the war our people were considering military preparedness.

There is another form to which our energies should turn and that is our own intellectual preparedness. It is fitting to remember that the best blood of England, France, and Germany has been lost. The younger generation which was to carry on the standards of civilization, of art, science, and literature, has been in part annihilated. Kipling's son, Osler's son, Sir Edward Schaefer's son, are dead, and so on by the tens of thousands.

It is not financial wealth alone that America possesses. She also has scholars who have been trained in England, France, and Germany, who have brought the knowledge of those countries here, and who have by their activities enlarged the scope of the world's intellectual progress. The process has continued so that the United States now affords training in almost every branch of intellectual world endeavor. But such opportunities fall far short of the necessities of the time.

We Americans who know of the movements of the modern educational world should wish to preserve intact the opportunities which have existed in Europe for advanced study and research, and not risk the possibility that these things pass away and become forgotten, even as Science and Art decayed after the Thirty Years' War.

The project which is to form the argument of this paper is the mobilization of the medical resources of New York City for the foundation of a great medical school which will be an honor to the city and a benefit to the medical culture of the world.

There are three medical schools in New York City, all classified by the American Medical Association as belonging to the first class. One or two of these could be developed into educational institutions which would be truly worthy of our national greatness. A medical school of the best type is a welfare center. It confers its blessings not only upon the hospital patients who have treatment by its distinguished professors, but it also sends forth highly trained men who have to do with the health and often with the morals of the whole community.

The public benefits conferred by modern science have been greatly underestimated in this country. Medicine can advance only by the scientific method. A well-known clinician recently complained that his students were no longer taught the proper things, that they no longer understood the significance of the heart sounds. On the face of it this seems dreadful. But the truth of the matter is that while the older clinicians *thought* they knew the significance of the heart sounds, a younger and more critical generation is using all the modern instruments at hand and all the intellectual reasoning power it possesses to obtain valid evidence of the significance of the heart sounds, and yet finds itself still groping in the dark. It is in the laboratories, with their exact methods of analysis, that accurate interpretation is to be sought. So a great medical school must be founded on a scientific basis if it is to fulfill its mission in the world.

It seems that it would be wise to support the interests devoted to teaching medicine in New York to the end that a powerful national influence may be exerted for making the standard of medicine the best in the world.

It would require $30,000,000 added to existing resources[1] to create a great Manhattan Medical College. Property worth $60,000,000 would closely approximate the total resources of Columbia University today. To the objection that $30,000,000 is too large a sum to be used for such a purpose as the elevation of medical standards in this country, let it be remembered that it is less than one half the cost to the United States of one day of war and scarcely more than the cost of a single battleship. And yet this sum, if properly used, would establish forever an asset of incalculable value for the health and welfare of the people. The budget of the Carnegie Nutrition Laboratory is $50,000 a year, a large sum from a princely endowment, and it is only half of one-thousandth part of one per cent of what the American people spend annually for food. It has been estimated that the economic loss to the United States from typhoid fever and malaria amounts to a billion dollars a year.

If a New York or Presbyterian hospital could be built and substantial laboratories constructed near it, the necessary physical equipment would be provided. A large amount of income should be spent in supporting men of brains. With the low rate of salaries prevailing among the laboratory men it would be easy to guarantee the continuance of their present salaries in any new institution, or at least to protect such laboratory men as accept no outside fees for their services. There is no question that if the success of this scheme were to depend upon it, the professors in the clinical branches who are almost universally in receipt of incomes far in excess of their academic salaries, would tender their resignations so that such clinical departments as are not properly organized could be reorganized on the basis of the best that the country affords.

The laboratories of such a school should be devoted to pure scientific investigations. Permission to do outside work for private pay within university laboratories has wrecked many a promising scientific career. Some of the clinical professors, perhaps those associated with the New York or Presbyterian hospital, might be kept free from private practise. Others, perhaps those associated with Bellevue Hospital, could be allowed to practise medicine after four hours of service daily in the hospital, but such men should receive little or no salary, although their staffs should be full-time men. An exception to these rules might be made in permitting outside work if this were done in the service of the state. The state could then command the service of a body of disinterested experts and this would be of great value in the administration of justice.

If a new Manhattan Medical School maintained two clinics in medicine and students were allowed to attend whichever course they chose, an element of competition now lacking would be introduced. In the same way with the subject of chemistry, one set of men could give a course lasting four months to be followed by a course given by another set of instructors. The same laboratory could be used. Each instructor would then be free for research work at least six months in the year. The student could choose the course he preferred, the better students, of course, being given the first choice.

The venture should be largely in the hands of university men, teaching students who have had at least a certain amount of university training and it would be a credit and a glory to the city of New York.

[1] The existing resources are already respectable. The cost of the new Bellevue Hospital, which is largely used for teaching, is estimated at $8,000,000. The combined resources of the New York and Presbyterian hospitals, which both enjoy the benefits of medical college affiliation, are $12,000,000. The medical schools themselves own property and endowments not far from $10,000,000. This makes a total of $30,000,000.

Courtesy of Underwood and Underwood and Doubleday Page and Company

THE BEST KNOWN PORTRAIT OF ROOSEVELT

It is thought by some that this portrait of the late Colonel Theodore Roosevelt was his first choice. It chances that NATURAL HISTORY has never included it among the numerous portraits of Roosevelt previously published and is glad to present it at this time for the excellence of the portrait itself, and as a record. Mr. Abbott uses it as the frontispiece of his book. Everyone who reads this book will be impressed with the simplicity and sincerity of it, and the vast new matter presented; and will appreciate also the author's aim "to supply some useful details for the final portrait which will be painted by the historians of the future"

Lawrence Abbott's "Roosevelt"[1]

By HAMLIN GARLAND

Member of the American Academy of Arts and Letters

LAWRENCE ABBOTT'S *Impressions of Theodore Roosevelt* is not correctly named. It is not a series of impressions but an authentic, indisputable record. Few men had the opportunity for studying Roosevelt at such close range, in such diverse fields of activity, and from day to day, as the writer of this book enjoyed. There are many to claim friendship with Roosevelt, but few who are as fully entitled to that distinction as Lawrence Abbott of the *Outlook*.

Although unassuming in its title, this book is of such value that it cannot be overlooked by any future historian. Without especial distinction of style and almost without construction, it nevertheless tells the reader just what he wishes to know concerning certain disputed points of Roosevelt's career. Its calm statement of fact with regard to the relationship of Taft and Roosevelt, for example, shows the large-minded action of Roosevelt at one stage of the controversy.

"He was always ready to renew friendly relations with an antagonist," Abbott writes, "unless they had been broken because of some fundamental vicious streak in his opponent which could not be remedied by any kind of readjustment."

New light is also thrown on the campaign of 1912, and on the Panama project, wherein Roosevelt's action is still a matter of dispute even among his friends. My own concern about these subjects is that of interest in the character of Roosevelt. Political issues are vital now only by reason of his participation in them. In Abbott's account the reactionaries are made responsible for the division of the Republican Party in 1912 (according to material here offered for the first time) and Roosevelt is shown to us in the act of refusing to compromise in the slightest degree on the moral question involved in the great struggle in Chicago. This is one of the most important and stirring passages in the book, for it shows Roosevelt in his highest mood as a political leader.

He was a redoubtable warrior, but he was a manly and generous warrior. He was, as the saying goes, a "good sport." To the man who fought fair he had only praise even if he was worsted by him, but the man who hit below the belt was not forgiven. The question "Who was responsible for the wreck of the Republican Party in 1912?" will be answered according to the reader's prejudices, no doubt, but Abbott confirms my own convictions in the case by presenting the documents which are needed in the final judgment.

In the famous dispute concerning the Guildhall speech Abbott's testimony is again of definitive character. Roosevelt wrote his Guildhall speech during his journey of six or eight weeks in Europe, declares Abbott. "He sought and accepted suggestions as to form and phraseology—this I know, because at his request I read the speech two weeks before it was delivered." This should dispose of the criticism that it was "a piece of Rooseveltian impulsiveness." In truth it was exactly a characteristic piece of Roosevelt *preparation*. Impulsive in action, he brooded over his problem with complete concentration before he

[1] *Impressions of Theodore Roosevelt.* By Lawrence F. Abbott. Published by Doubleday Page and Company, 1919.

Courtesy of Doubleday Page and Co.
From a photograph of Roosevelt taken in 1912 at his desk in the office of the *Outlook*

acted. His leap was swift but his preparation deliberate.

The parts of the book which are of most interest to me, however, are those which touch upon Roosevelt's love of books and of nature. In these he was at his highest and best. They tell of the Roosevelt I knew, the Roosevelt who could write like this: "Across the lonely wastes the sun went down. The sharply channeled cliffs turned crimson in the dying light. All the heavens flamed ruby red and faded to a hundred dim hues of opal, beryl, and amber, pale turquoise and a delicate emerald; and then night fell and darkness shrouded the desert."

This passage recalls to me a talk we once had concerning the beauty and loneliness of the Bad Lands of Dakota. For a man of infinite and endless activity, he was singularly contemplative. He had his moments when he was but a mind in the midst of wild scenes, and reacting to wild voices. On most themes his manner of writing, while clear and forceful, is lacking in grace, in charm, but when he wrote of nature, of the wilderness, his prose was often impassioned almost to the point of poetry. Some parts of his book on Africa, and especially certain passages in *A Book-lover's Holidays in the Open*, have a vibrant rhythm which adds to the truth of his description a lasting musical charm.

Abbott's division of Roosevelt's personal qualities under the heads of Caution, Courage, Humor, and Gentleness, will come as a surprise to many who knew only one side of the man. His courage and his humor most men know, but few know, as Abbott knew, the gentle and chivalrous side of Roosevelt.

It is significant and helpful to find the book ending on this note: "Theodore Roosevelt's personality was an unsurpassed combination of the unterrified fighter of what he believed to be the worst, and the tender-hearted lover of what he believed to be the best in mankind." And, in another place, Abbott says, "There was not a tinge of jealousy in his disposition. He was not a philosopher, he was simply human. He took the hard knocks of life not with resignation but with a kind of boyish zest and joy."

In short, Abbott presents in this book the Roosevelt I knew, but with a fullness of observation which was denied me. It is a delightful as well as an authoritative record.

Application of Psychological Tests in Army Camps[1]

By GEORGE F. ARPS

Ohio State University; lately Major, U. S. A., Chief Psychological Examiner, Camp Sherman, Ohio

In considering the subject "Psychological Tests in Army Camps," it is understood that I am here detailing the service rendered by the psychological examining station at Camp Sherman, Ohio. What was done at Sherman is fairly typical, I think, of the procedure and results attained wherever psychological examining stations were in complete operation. So far as this may be the case, I am permitted to speak for the service in all camps where the psychological service was made available.—THE AUTHOR.

IF it was important that America discover quickly the best brains among her recruits and assist in placing those competent in positions of leadership and responsibility commensurate with the enormous task then confronting the nation, if it was important to weed out the relatively "dead" brains that endangered the lives of those engaged in the combatant units of the military service, and if it was important to increase the efficiency of all extra military organizations engaged in promoting military efficiency, then the psychological service, it may pardonably be said, made a valuable contribution to the military arms of the nation.

Hundreds of thousands of young men from practically every known occupation poured like a stream of immense volume into the various army cantonments, there to be speedily organized into companies, battalions, regiments, and divisions. The multitude being assembled, the concrete problem of whipping and shaping this huge mass into an effective fighting machine within a few months confronted American genius.

Obviously the reduction of this mass of men, representing the most divergent interests, divergent social standing, divergent occupations, divergent nationalities, into an orderly, disciplined fighting machine, was a plain matter of selecting the best brains for positions of leadership, of selecting men of decision, clear vision, conviction, energy, determination,—in short of selecting men unmistakably possessed of superior intelligence and of unimpeachable integrity. These men to the extent of tens of thousands were indispensable as commissioned and noncommissioned officers.

How to select the most intelligent, how to select them quickly and with the minimum of error, were among the immediate pressing problems. Upon the officers, and especially upon the noncommissioned officers, devolved the problem not only of reducing this conglomerate, inarticulate aggregation of independent, undisciplined American young men into an army of disciplined soldiers, but upon the officers fell also the important work of developing military morale, stamina, and spirit. These elements, all more or less latent with respect to mass action, considered from the military point of view depend almost altogether for their development and coördination upon the commissioned and noncommissioned officers.

The *first* and most important service which a psychological examining station renders consists in furnishing commanding officers with a mental rating of every recruit as soon as possible after his induction into the service. These ratings are entered on the service records of every soldier and may be consulted by the commanding

[1] A paper read before the American Psychological Association, 1918.

officers before selecting noncommissioned officers; by the authorities charged with the duty of selecting the best material for the various officers' training schools; and by officers in balancing organizations—and in many other ways. This procedure constitutes a short and practically accurate method of selecting the type of man necessary for the construction of a modern army in record time. It is infinitely superior to the method of rough observation and guess which of necessity prevailed, more or less, prior to the introduction of psychological tests. In speaking of the "guess method" one commanding officer remarked: "I have given up trying to estimate intelligence by observing 'anatomical topography' and various other phrenological symptoms of mentality."

The standard for admission to any officers' training school—infantry school of officers, machine-gun school, artillery school, quartermaster school, and signal school—was almost entirely confined at Camp Sherman to candidates who were *very superior* and *superior* men mentally as determined by the intelligence tests. It does not follow that all candidates so rated were selected, for the psychological tests are by no means free from error. Moreover, there are other *very important* factors which help to determine a candidate's total value to the service; these must be considered in conjunction with the intelligence factor in determining fitness for commissioned service.

It was the opinion at Sherman that, in view of the supply of superior and very superior men, and, in view of the fact that a noncommissioned officer, under emergency circumstances, may assume direct and independent command, the intelligence qualification for the noncommissioned officer should closely approximate that of the commissioned officer. There was a distinct trend in this direction in the minds of certain of the military authorities at Sherman. Had the war continued, it is not unlikely that most interesting developments would have resulted in the division forming when the armistice was signed. In one division, at least, it was very probable that the intelligence curve of the noncommissioned officers would have paralleled that of the commissioned officers.

These statements gain enormously in significance when we reflect that in a single organization about fifty noncommissioned officers and first-class privates were sent to the school for illiterates. The consequences of leadership of this degree of intelligence do not involve a serious task on the imagination; on the other hand, it may strain considerably the feelings and confidence of those vitally concerned with the welfare of the men commanded.

The *second* important service rendered by the psychological examining station consisted in rating all commissioned officers below the rank of major in the camp. A number of commissioned officers requested the examination of their entire commands, including men of higher rank. This was our recommendation in view of the fact that candidates for the various training schools must have, as a rule, an "A" or "B" ("very superior" or "superior") rating and that promotions into the higher ranks are quite generally made from the lower. There were other reasons, but these appeared sufficient to justify the recommendation. All this is obvious from the procedure in the camp surgeon's office with respect to the promotion of commissioned officers into higher grades. For example, a lieutenant up for a captaincy appeared before a committee, of which the surgeon was chairman, for examination. This was at first done independently of the intelligence rating. The results of the initial work of the committee showed the very interesting fact that every man promoted had received an intelligence rating according to the psychological tests of "A" or "B," and that every officer, with one exception who failed to receive promotion had been rated below "B" in intelligence. Thereafter, the work of the examining committee was considerably abbreviated and no candidate for promotion appeared before the committee in advance of the results of mental examination.

A *third* service by the Camp Sherman station made possible the conduct of the development battalion schools along lines of accepted modern pedagogical procedure. A complete plan of procedure and organization was presented to the battalion school officer who at once accepted the plan. The administration of these schools was made possible by memoranda issued by headquarters of the depot brigade. According to this plan, the teachers were selected by means of psychological tests; the student soldiers were initially classified according to their intelligence ratings, thus securing a fairly uniform tempo of learning for each class. After two or three weeks of actual classroom experience the men were re-classified. The armistice interrupted, almost at its inception, what appeared to give promise of being an extremely valuable educational experiment, upon which those concerned with the problem of illiteracy and with the Americanization of our foreign population could very profitably bestow at least one intelligent moment.

Fourth.—The psychologists assisted the psychiatrists in eliminating low grade mentals whom it would be dangerous to retain in any line organization. Frequent assistance was extended the division psychiatrist in making a final survey of units about to leave for overseas.

At a later date when the psychological examining stations were more completely organized, the recruits, as they entered the receiving depots, were thoroughly combed so that only an occasional low grade succeeded in getting by the psychiatric and psychological examiners. Thus was the army made mentally as well as physically "fit to fight."

It is obvious from the above that the psychological service played its rôle in the all-important problem of selecting the *best brains* for positions of leadership on the one hand, and, on the other hand, in the elimination from active line duty of the puny, putty brains so well calculated to gum up the military machinery.

Fifth.—The commanding officer of the base hospital requested a complete survey of his personnel. This included commissioned men of all grades, all noncommissioned officers, and all enlisted men. The camp adjutant made use of intelligence ratings to a very large degree in assigning enlisted men to base and evacuation hospitals organizing for overseas duty.

Sixth.—As in the case of the base hospital, the commanding officer of the medical department of the depot brigade requested a survey of his organization. Here, as elsewhere, most of the noncommissioned officers were selected before the psychological work was in full operation, which accounts for the relatively large number of intelligence grades below that of "B." The value of this survey is indicated by the commanding officer's communication which is fairly typical of the medical attitude. He says:

"It is now the procedure in this department to select, as likely men for training with a view to advancement, those who show an intelligence from High Average up, giving proper value, of course, to such other factors as application, personality, physical qualities, etc. It seems sure that this will obviate selection and, later, failure to make good of some who might otherwise creep in."

Seventh.—By request of the division and camp surgeon all members of the army nurse corps and the student army nurses were examined. The Colonel, in making the request, emphasized the very great importance of the intelligence factor in the nurse service. The tests were of value in organizing the service and in making assignments to places of greater opportunity and responsibility.

Perhaps it should be emphasized again that the psychological tests lay no direct claim to measurements of such factors as reliability, determination, grit, industry—all very important factors in arriving at the total value of any person in the military service.

Eighth.—The psychological service was placed at the disposal of the commanding officer of the prison ward and the camp psychiatrist in examining all base hospital prisoners and drug addicts. Intelligence ratings functioned to some extent in determining treatment (not medical), and in furnishing assistance as to the ultimate disposition of these unfortunates.

Ninth.—At the earnest solicitation of the commanding officer of the camp of conscientious objectors the psychological board made a fairly complete mental and sociological report on each man who classified himself as conscientiously opposed to military service. While recognizing the existence of the genuine objector, it is preferable to remain within the bounds of printable English and refrain from comments applicable to a very considerble proportion of this unsavory group.

How the psychological ratings functioned in the interpretation, disposition, treatment, and understanding of this motley aggregation of disparate elements can best be portrayed in a blanket statement of their commanding officer. He says, "It is not extravagant to say that the intelligence rating and survey of each case have been almost invaluable. I do not hesitate to say that without this information I could well be compared in the conduct of my work to a blind man groping in the dark for an unseen goal."

Tenth.—By camp memorandum the entire personnel of the quartermaster department, the remount station, the guards at the German prison camp, and all other military organizations which had not previously requested examination, were surveyed and reports forwarded to the proper commanding officers.

Eleventh.—All candidates for (1) infantry officers' school, (2) machine-gun school, (3) artillery school, (4) quartermaster school, and (5) signal school were given psychological tests and the results used in determining entrance to these various schools. The president of the examining board makes the following comments: "It is the unanimous opinion of the Board that an intelligence rating is *the* one most reliable index, in that a quantitative statement is available and in that rough observation is effectively checked. The psychological rating is, therefore, considered of primary importance."

Twelfth.—Camp Sherman had but one officers' training school, the fourth. The psychological board furnished the commanding officer at his request an intelligence rating for each man in the school for whom there was no rating. It was the commanding officer's opinion that the intelligence ratings were of the highest value to the military service; he suggested that the examination be given simultaneously to all units of a division as soon as possible after organization.

Thirteenth.—The division and camp surgeon of the eighty-fourth division requested a rating of his office personnel, as did likewise his successor.

Fourteenth.—The psychological service extended beyond the strictly military organizations. The social workers and the chief medical health officer enlisted this service in the examination of a considerable number of prostitute and questionable women who, as is well known, infest the immediate environs of army camps.

Many examinations were made in the county infirmary where the women were quarantined pending treatment and ultimate disposition; others, fewer in number, were examined in the county jail and in the city bastile. Whenever possible a psychiatric examiner accompanied the psychologist. A combined report was then forwarded in duplicate, one to the health officer and one to the chief social worker. This service was continued to the very close of the psychological work.

Fifteenth.—The general secretary of the Young Men's Christian Association desired a survey of his personnel in the hope of increasing the effectiveness of his organization. It was the secretary's idea to employ intelligence ratings in the assignment of men to varying types of work. It was his suggestion that all prospective "Y" workers be given psychological tests in advance of appointment. Moreover, it was expected that the tests would aid in eliminating candidates possessed of excessive emotionalism.

Sixteenth.—A service similar to that performed for the Young Men's Christian Association was extended to the Knights of Columbus organization. The general secretary remarked: "It would be of great service to us if you would kindly give tests to candidates for positions with our organization; their employment could then be made with the psychological results in mind."

Seventeenth.—As in the case of the Young Men's Christian Association and the Knights of Columbus, the Jewish Welfare Board was examined with similar objects in view.

Eighteenth.—By permission of the camp commanding general about two hundred German war prisoners were given the psychological examination.

In addition to the above organizations, fourteen heads of educational institutions in the regional directorship comprising the states of Ohio and West Virginia requested psychological examinations of members of the student army training corps. The paralytic effect of disapproval prevented the immediate realization of a piece of work which appeared of great importance to those familiar with the selection of candidates for officer training schools.

Practically the same unhappy fate befell the urgent request for assistance in the selection of candidates for officers' training schools by the commanding officer charged with this duty at the Columbus, Ohio, army post.

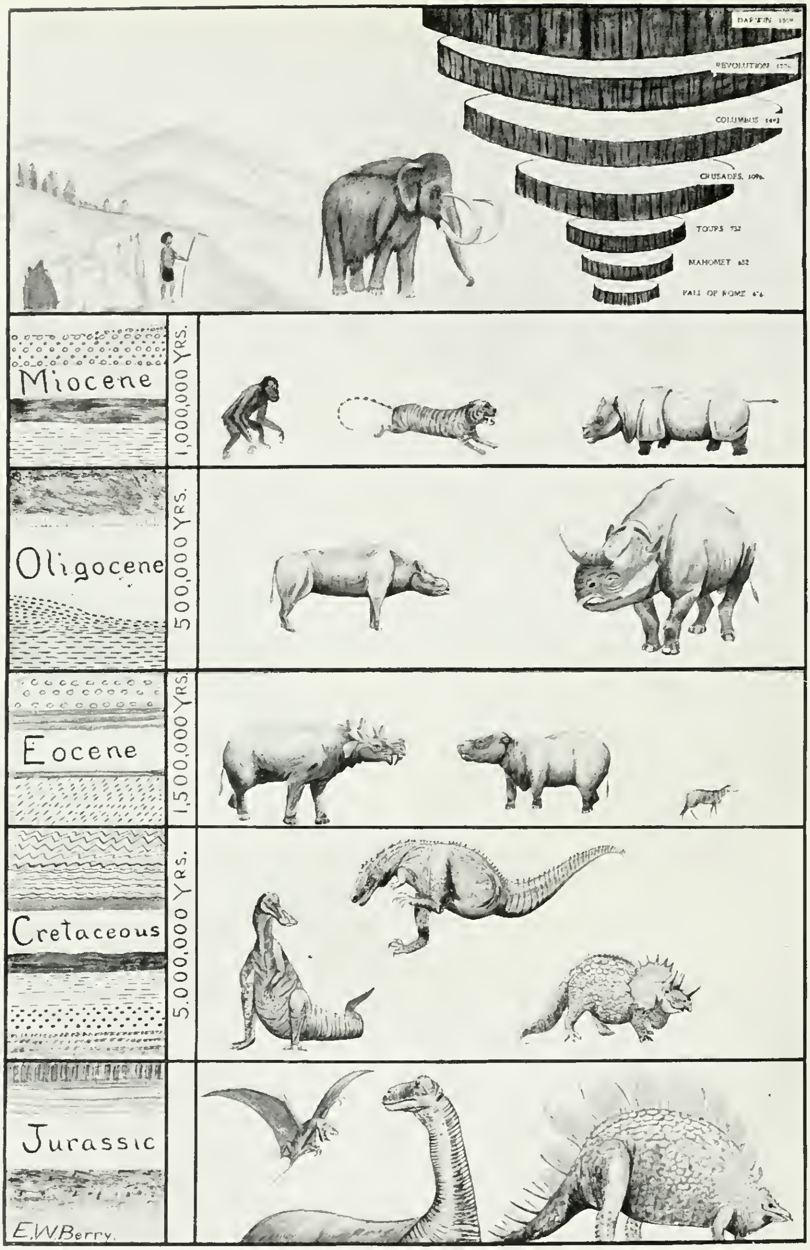
The various lines of activity thus briefly indicated cover in a general way the work of the psychologist in army camps. Touch any phase of any line of the army service and the question of intelligence at once pops into the foreground. Diagnose the wrongs and complaints of the Army, analyze the complaints of the buck privates, noncoms, and commissioned officers! Almost invariably they are traceable to an insufferable lack of intelligence, misplacement of men, and practically not at all to ignoble intentions, save as such intentions emerge from wingless brains.

Concerning the utility and perversions of army discipline, one buck, in response to a questionnaire, replied: "It all depends upon how much brains God gave the officer." It was also suggested that plumbers, blacksmiths, and skilled machinists were hardly suitable in army kitchens, and that the kitchen detail "should have sufficient intelligence to unharness the horses before they cook them."

Ignorance and stupidity are the breeding grounds of nine tenths of all grievances in the Army. This is implied in one officer's criticism to the effect that the Army "had 50 per cent officers and 100 per cent men."

It is apparent that selection through scientifically devised mental tests, for native ability, that is, innate capacity, inborn talent, is equal in importance to physical fitness and to fitness as determined by tests for conventional learning. Such traits as common sense, judgment, reasoning, and attentive control are matters of endowment and cannot be measured by the ordinary methods of examination common to every step of the educational ladder from the primary grade to the highest technical institution of learning.

For the introduction and approval of the psychological service the nation is indebted to the genius of General Gorgas, Surgeon General of the Army at the outbreak of the World War, and to the vision of Major Robert M. Yerkes, at the time President of the American Psychological Association.



CONTEMPORARIES OF THE SEQUOIAS

Above at the right, are shown a series of tree sections illustrating the growth of a single living big tree (*Sequoia gigantea*) in relation to human history. The largest of the trees in Sequoia National Park had sprouted before the first Olympiad, 776 B.C., or before Carthage was founded.

Below, is given a partial geological section in which are grouped the animal contemporaries which have accompanied the Sequoias at various times since their rise among the great dinosaurs and pterodactyls of the Jurassic. The Sequoias overtowered and survived the giant reptiles of the Cretaceous, the "dawn horse" and huge ungulates (Amblypoda and Titanotheres) of the Eocene, the *Brontotherium* of the Oligocene, and the rhinoceroses, saber-toothed tigers, and early primates of the Miocene. In the last-named period they reached their greatest geographical expansion. The fossil remains, especially the cones, of the Sequoias are exceptionally resistant, and so render a very complete geological record

The Ancestors of the Sequoias

TREES WHICH HAVE A HISTORY OF TEN MILLION YEARS, AND ARE TODAY PASSING INTO OBLIVION

By EDWARD W. BERRY

Professor of Palæontology, Johns Hopkins University

IN the days when the world was considered to be only about six thousand years old and when the few known fossils were considered to be the visible evidence of Noah's flood, it was scarcely remarkable that no one was interested in tree ancestors. In these days, however, with the passing of our virgin forests and the great interest taken in preserving some of our threatened species from extermination, it is a matter for surprise that the thought that these noble races of plants had ancestors is but rarely entertained.

Tree genealogies, it is true, present little of the dramatic as compared with the wonderful American evolutionary series of the horses or camels, and yet most of our familiar forest trees are of more ancient a lineage, and some, like the Sequoias, go back almost to the birth of the tiny progenitors of the warm-blooded animals. Although the book of the future is tightly sealed, that of the past needs but understanding wedded to imagination to be legible even though its torn pages are the rocks of the earth's crust.

The chapters of this book of history where the records of the Sequoia occur are those chapters from late Jurassic time down the ages to the present. The entries of the Sequoia ancestry comprise innumerable leaf-bearing twigs, many cones, fragments of wood, and occasionally, as in Yellowstone Park and at Florissant, Colorado, mighty silicified trunks petrified into forests of stone and buried by tremendous showers of volcanic ashes.

Sequoia remains resist decay admirably, so their chances of preservation as fossils in the rocks are much better than those of most plants. The cones, especially, are very common in the geological record, and a favorite method of preservation is as ferruginated mud casts. I have collected these from the Lower Cretaceous of Maryland, from the Upper Cretaceous of Kansas, and from the early Tertiary of Dakota. Cones almost identical with those of the existing redwood are abundant in the present arid Bad Lands of western Dakota, denoting very different climatic conditions in that region in past ages.

The earliest known Sequoias come from the late Jurassic. They first became widespread, however, during the later Mesozoic, radiating from their original home, which was probably in the Arctic archipelago, southward to western Europe and North America, and along the eastern coast of Asia. (See sketch map at the left, page 155.) Little is known of Asia at that time, but North American Cretaceous records are innumerable, extending from the Atlantic to the Pacific, and southward to southern Mexico, and there is one record from Argentina, which, if the identification is correct, means a migration from North America across the equatorial region and the origin of the Tertiary species found in Chile.

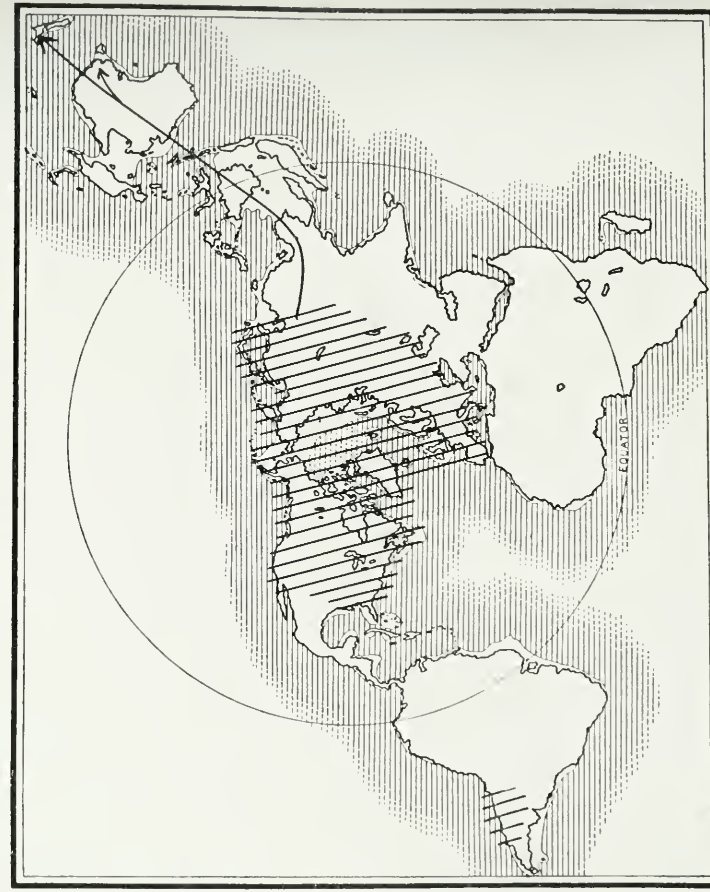
It is during the succeeding older Tertiary, however, that the Sequoias reached their widest limits of distribution. (See map at the right, page 155.) Europe and North America were fairly covered at one or another time during this period. Asia has furnished many records, and somewhat questionable evidence points to the extension of the Sequoia range to Australia and New Zealand. No records for any period of Sequoia history have been furnished by southern Asia and Africa, and all of the known Tertiary records are outside of the tropics and almost exclusively in the North Temperate and Arctic zones, for Greenland, Iceland, and Spitsbergen were colonized, as well as Siberia, Alaska, and the Arctic coast of North America, during the older Tertiary. Sequoia twigs are common in the Tertiary coal measures of southern Chile, as I was at pains to verify during a recent visit to that most interesting region. They are found in Europe as late as the time immediately preceding the Glacial period.

Today the two existing survivors of this ancient race are our oldest trees: one might appropriately term them existing fossils. The accompanying figure shows the evolution of animal life witnessed by these ancestral Sequoias. It was printed fifteen years ago and is republished through the courtesy of the *Scientific Monthly* (formerly known as *Popular Science Monthly*). The picture owes its original existence to the creative art of Mr. Charles R. Knight and the liberality of Professor Henry Fairfield Osborn, and although our conceptions of some of the details of these restorations have changed somewhat with a better understanding, the drawing will still serve as a dramatic portrayal of the past. The millions of years during which Sequoias have flourished have seen striking changes in the animal kingdom, from the uncouth dinosaurs and flying reptiles of the Mesozoic through the evolving mammals of the Tertiary to the Age of Man.

Equally great, if less obvious, changes have taken place in the vegetable kingdom, for the first Sequoia lived amid a flora of ferns and cycads, and there were no representatives of the flowering plants—the mammals of the plant world—in those far off days. The flowering plants are the most specialized, the latest to appear, and the dominant existing race of plants—the race that made possible human civilization, since all of our food plants, upon which modern as well as primitive cultures rest, belong to this race.

I have said nothing of the majesty of this royal line of trees, nor of their individual size or longevity. It is a story that has often been told. The largest of the trees in the Sequoia National Park had already sprouted before the first Olympiad or before Carthage was founded, that is, in the days of the Judges in Palestine and the first flowering of the Assyrian Empire. The redwoods are somewhat more abundant than their brothers, the "big trees," less massive and shorter lived, but they are more like those fossil species whose structures have been investigated. Moreover, they are more accessibly located, more easily lumbered, as yet unprotected by law, and hence more in danger of total destruction.

That we do not treasure the Sequoias or any of our forest trees sufficiently is a reflection upon our democracy. I sometimes wish that we moderns were less pragmatic and that our bump of reverence was less vestigial, for then not only the redwoods but all of our trees might become as sacred as they deserve to be, and even a lumber trust might hesitate to turn these abodes of the gods into waste places. Our forests, like the stars or the changing seasons, are wonders whose lessons and value have become dimmed because of long familiarity. If we saw them but once or twice in a lifetime they would be treasured accordingly. One has but to dwell in a treeless desert for months to have awakened within him such a love for the forests as will last forever.



MAXIMUM DISTRIBUTION OF SEQUOIAS

During Mesozoic Times, the Age of Reptiles (see map at the left), and during Cenozoic Times, the Age of Mammals (map at the right)

The two extant species of Sequoia, the big tree and the redwood, unique among trees for age and size, are the restricted survivors of a once widely distributed genus. Their dispersal began in the early period (Jurassic) of the previous geological era, the Mesozoic or Age of Reptiles, and during this age they probably radiated from the Arctic archipelago southward over western Europe, North America, and the eastern coast of Asia. Twigs, cones, and seeds were left abundantly among the Lower Cretaceous or Comanchean rocks. During the Tertiary period of the succeeding Cenozoic era or Age of Mammals, the Sequoias reached their maximum distribution over practically all of Europe and North America, a large part of Asia, and southern South America. *Sequoia langsdorfii*, the direct ancestor of the redwood, was predominant in the great circumpolar forests of the late Mesozoic, and *Sequoia magnifica*, almost identical with the redwood, left the petrified trunks found in Yellowstone Park and at Florissant, Colorado. During the cold Pleistocene which preceded our recent geological period, the Sequoias disappeared except in the Pacific coast area where they are still dominant

MOUNTAIN FOLIAGE ALWAYS DRENCHED IN MIST

The vegetation of the Blue Mountains of Jamaica, and to a certain extent of the John Crow Mountains as well, is very luxuriant and abounds in ferns and mosses. Heavy rains and mists which constantly sweep over the slopes induce a riotous growth. Epiphytic bromelias lodge on all the larger limbs of the forest trees, and fine trailing ferns seek a foothold on every tree trunk and on every bank

A Zoölogist in Jamaica[1]

By H. E. ANTHONY

Associate Curator in Mammalogy, American Museum of Natural History

AT the time of Gosse, the English naturalist who summed up the knowledge on Jamaican zoölogy about the middle of the last century in that delightful classic, *A Naturalist's Sojourn in Jamaica*, the island of Jamaica could claim for its native mammalian fauna only two species, exclusive of bats. These were the so-called Indian cony (*Geocapromys brownii*) and a rice rat (*Oryzomys antillarum*). Since Gosse, various contributing agencies, among them the introduction of the mongoose, have wiped out completely the rice rat and brought to the verge of extinction the Indian cony. Such a state of affairs could scarcely be expected to attract a mammalogist to Jamaica, nevertheless the plans of the department of mammals of the American Museum of Natural History, as a part of a comprehensive scheme for West Indian research, called for an early reconnaissance of the island and disregarded the apparent poverty of the fauna, trusting rather to the predictions that could be made on the basis of past work in the Greater Antilles.

Exploration in past years on Cuba, Santo Domingo, and Porto Rico, as well as on the smaller island of Anguilla, had disclosed the presence of a fossil fauna much more numerous, varied, and interesting, as far as mammals are concerned, than the one that is living there today. On these islands the fossils were found in formations from the late Pleistocene into the early Recent epoch, and the animals must therefore have flourished and disappeared before the advent of any man into the West Indies. There are two exceptions, two rodents which lived long enough to be a food item on the menu of the Arawaks, but passed into oblivion together with the Indians at the coming of the Spaniards.

These mammals formed a strange assemblage of curious and ancient ancestries, most of them with their closest relatives to be found back in the Miocene formations of Patagonia; while one of them, a peculiar, long-snouted, insect-eating animal that lived both on Porto Rico and on Cuba, as far as fossil records show, lost its last relative back in the Eocene beds of North America, making this island survivor outlast his mainland kin a matter of 5,000,000 years or more. The greater part of these fossils are rodents and vary in size from ratlike forms, the size of the domestic house rat, to giant gnawers

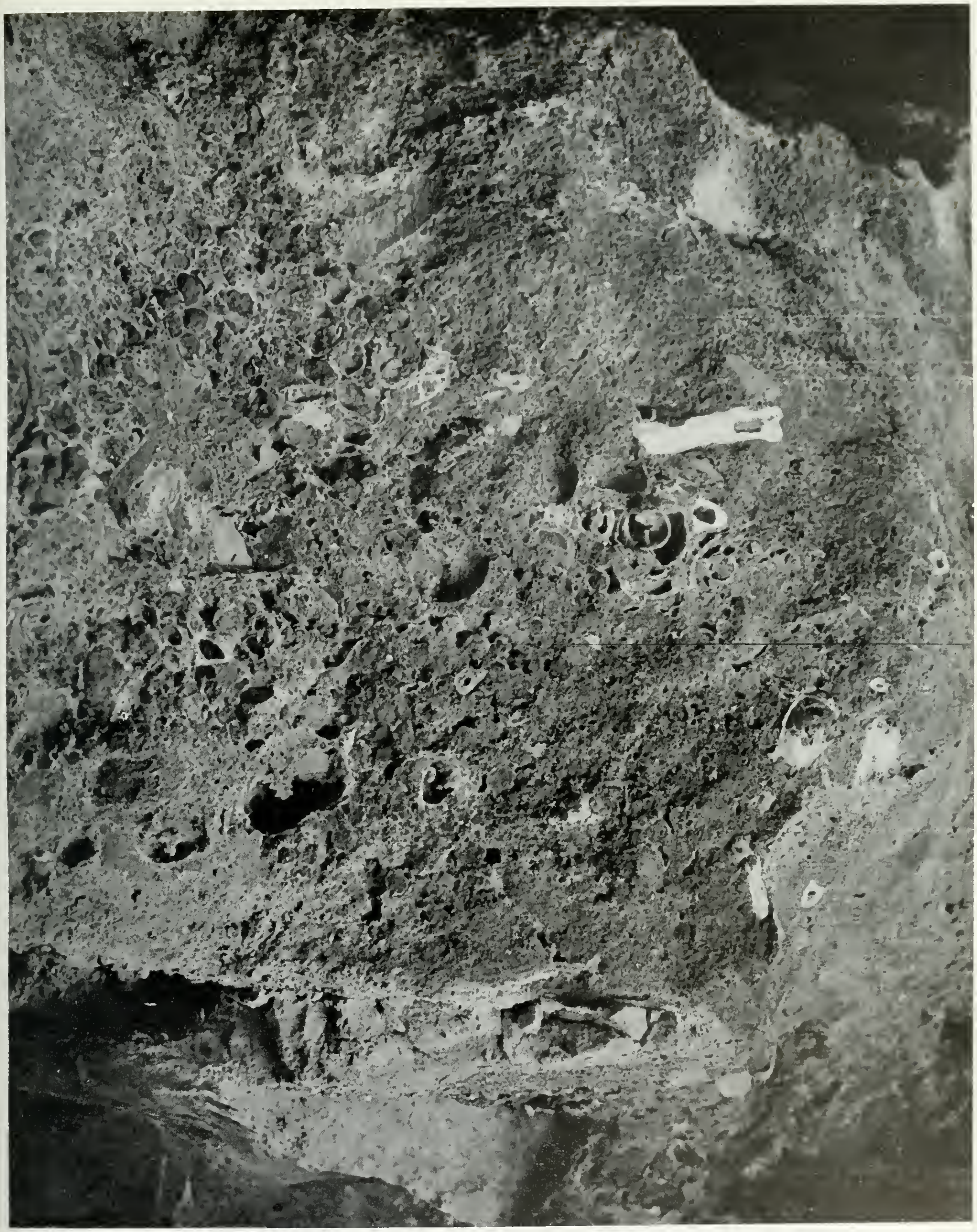
[1] The illustrations are from photographs by the Author.

that far exceeded in size any living rodent and attained a weight of perhaps 150 pounds. The largest forms, as well as those most likely to appeal to the popular attention as something very distinct from any mammal to be found living today, are ground sloths, ungainly, heavy-limbed edentates, distantly related to the slow-moving sloths of the present day, and like them, feeding on vegetation. The largest of these ground sloths was as large an animal as the black bear, but it had smaller relatives about the size of a fox terrier. The smallest mammals to be found in this fossil complex are insectivores, and the Cuban representative was comparable in size to the meadow mouse.

Although the first discoveries of fossil West Indian mammals were made in the latter half of the nineteenth century, the rapid extension of knowledge of this fauna did not come until about the time that the World War burst forth, and research in natural history gave way to the demands of the occasion. Unsuspected additions to the mammal inhabitants of Porto Rico, Santo Domingo, and Cuba at once aroused a dormant interest in the West Indies and exploration there received a vigorous impetus. The question of the arrival of these mammals on the various islands was explained by two different hypotheses. One school of investigators held that the islands must of necessity have been linked to the continental mainland at some time in the Tertiary, when the animals crossed dry-shod to take up what later became an insular abode. On the other hand, the antagonists of this theory maintained that the islands had no mainland connection in the Tertiary, but received their life through fortuitous methods of dispersal, chief among which were floating life rafts, great masses of caved-in bank, bearing vegetation and what not—such as yearly come down large rivers like the Orinoco and the Amazon and pass out to sea, carrying various forms of life that may have been trapped on them. The latter school held that the nature of the island fauna, so far as it was made up of mammals and such forms as were so restricted by quadrupedal locomotion as to need land connections for an extended distribution, argued against a land bridge because otherwise one should find more of the elements of a truly continental fauna. The discovery in recent years of so many new forms has in a measure added fuel to the controversy, for, while the number of forms has been increased greatly so that the life raft theory would seem to be overworked to account for them all, on the other hand the nature of the fauna has acquired a peculiar aspect, namely, that of an assemblage of rodents, insectivores, and edentates only, with none of the dominant mainland types from such groups as the ungulates, carnivores, and marsupials. One significant feature, however, that has been indicated by the discovery of closely related forms on adjacent islands, has been the gaining in favor of the hypothesis that all of the larger islands at one time in the Tertiary formed an Antillean continent of considerable extent. In this connection the island of Jamaica might well have been considered to hold the deciding evidence, since its possibilities had not been exploited and since its position, in relation to submarine topography, would bring it equally well into such an Antillean continent or into an eastward extension of the mainland from Honduras. The more than likely chance that new and interesting discoveries awaited the first mammalogists to make a detailed search for fossils led me to plan work on Jamaica as the first resumption of West Indian exploration after my return from military service.

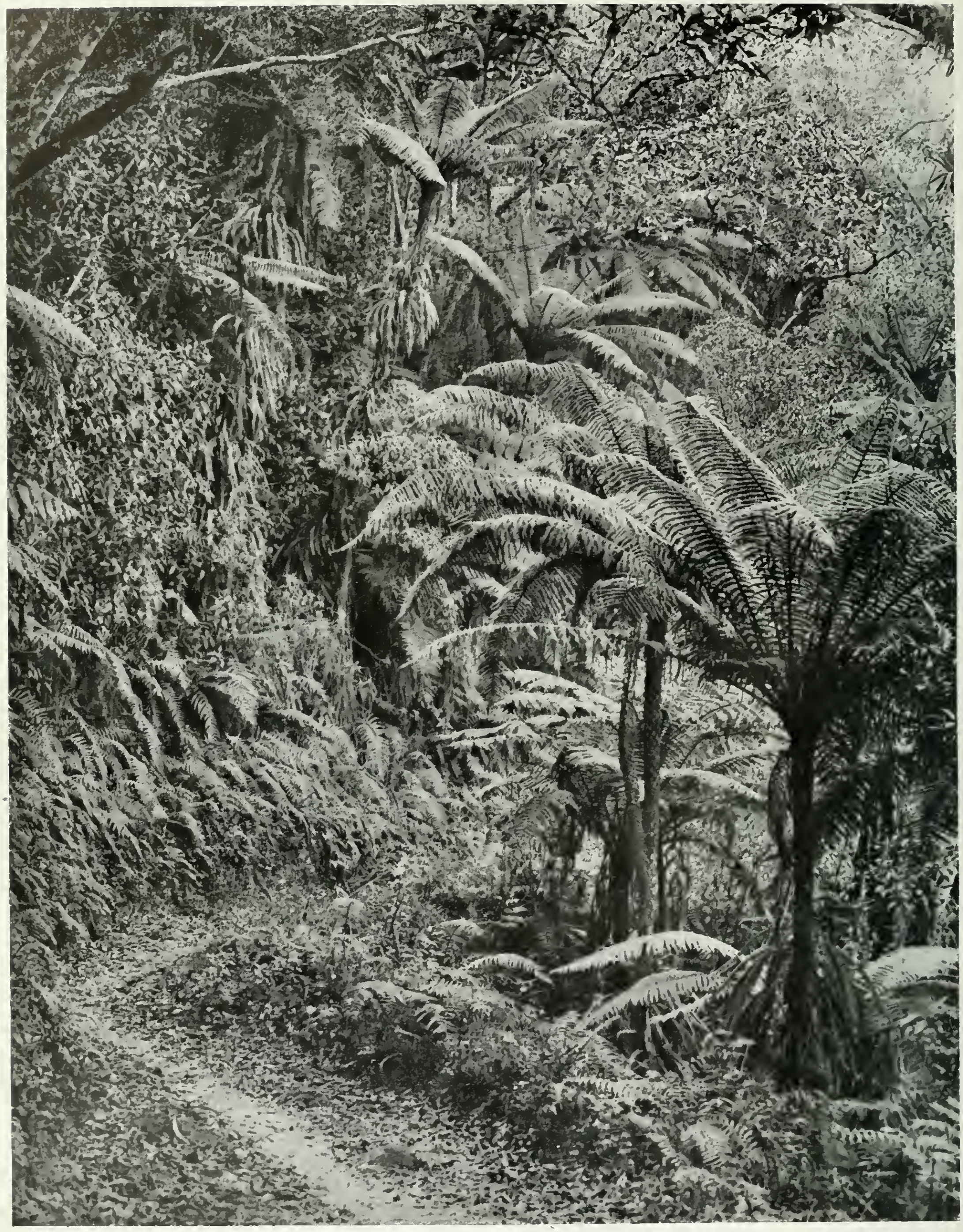
With an assistant from the department of vertebrate palæontology of the American Museum, Mr. Charles Falkenbach, I left New York for Jamaica November 19, 1919, and spent four months in as thorough a reconnaissance as such a short period permitted. The results of the trip have been doubly satisfactory, first in the acquisition of new and valuable material for the Museum collections, and second in the vindication of the belief that the West Indian fauna has yet many treasures to be unearthed.

In the West Indies the main source of all the fossil finds has been the limestone caves. Because of the geological nature of the Greater Antilles, which have extensive areas wholly of limestone, caves are of frequent occurrence, and in times gone by the mammals have made use of these caves, either as a daily refuge in which to live, or, in the case of old or diseased individuals, as places into which to crawl and die. Finally a species of owl, closely related to the barn owl of the mainland, has made these caves its home, and as it preyed entirely upon birds, small mammals, and reptiles, the



BONES PRESERVED IN A CAVE 100,000 YEARS

The great fossil discoveries of the West Indies have come from limestone caves where many of the animals of past ages pr[illegible]l and where others crawled away to die. The American Museum Expedition examined about seventy [illegible]. The richest in fossils was at Balaclava near the center of the island. Here were obtained large masses of a [illegible], hard limestone formation, containing pebbles, shells, and bones (as shown in the photograph) which will be chiseled and worked out with great care in the Museum laboratories. There have already been discovered in it a new rodent of most unusual size, a large terrapin, and a crocodile. The evidence points to the Pleistocene as the time when these animals lived, and the bones have been held in the limestone 100,000 years



IN HIGH ALTITUDES OF JAMAICA

The most conspicuous and the most beautiful feature of the environment in the higher parts of the mountains is the tree fern. Many species are known from Jamaica, and all are noteworthy for their clean-cut appearance, which makes them stand out sharply against the jungle background, and also for the vigorous green of their foliage pellets cast up cover the cave floor in some cases with millions of small bones, and have been the source of a great deal of material which could have been obtained by no other means. Accordingly the island was mapped out first in respect to the limestone areas, and trips were made into all of the most promising cave regions. We found that many caves must be visited in order to strike upon one that proved to have been so situated that it attracted the sought-for inhabitants; thus in all, about seventy caves were examined. As luck would have it, the richest cave of the entire trip was located at the very first station visited, Balaclava, a little west of the center of Jamaica, in the parish of St. Elizabeth.

Here was encountered, in a very small cave at the base of a limestone cliff, a breccia or conglomerate formation made up of earth, pebbles, and bones, all cemented into limestone by the action of water charged with lime, and a mass of valuable material was obtained. The most important mammal found in this formation was a rodent. If one may judge from the limb bones associated with and apparently belonging to the typically rodent teeth (which alone of all the material is at present sufficiently free of the matrix to allow of examination), this animal possessed a huge, disproportionate body structure, larger than any living rodent, and indeed surpassed in this respect by few rodents of any time. Until the material has been worked out of the concealing limestone in which it was collected, nothing but conjecture as to its form and relationships may be indulged in, but of its distinctness there can be no doubt. Associated with this large rodent were found a terrapin, larger considerably than the one living on the island today, probably a large tortoise, and fragments of a crocodile. This breccia was found cemented to the side and to the ceiling of the cave, and its position, taken in conjunction with other evidence, points toward the time of its formation as being in the Pleistocene, probably a matter of 100,000 years ago.

A like formation was encountered at one other locality on the island, and here also the evidence of antiquity was very strong. Throughout most of the island the caves were of too recent formation to contain such old deposits. For example, along the seacoast, where the last elevation of the island brought the coastal plains up out of the sea, although the caves were numerous they were invariably of quite recent formation and contained none of the interesting new fossils. The latter caves often did yield, however, remains of the extinct rice rat, thus showing that at no very remote period this small rodent had a widespread distribution and was so common that it formed an important part of the diet of the barn owl. The reason for its disappearance obviously lies in the advent of the ubiquitous Norway rat and the bloodthirsty mongoose, but the cause of the disappearance of the older, Pleistocene mammalia is not so apparent.

In numerous localities the records of the former Indian inhabitants were found.

The species known as the Jamaica barn owl has inhabited certain caves on the island for thousands upon thousands of years. This owl swallows its prey whole—mice, small birds, frogs, and lizards—and ejects from its stomach large pellets of the undigested fur, feathers, and bones. These pellets line the cave floors to the depth of a foot or more, often weighing many tons in the aggregate, and serve as a volume of natural history to the investigator, and an invaluable record of the changing animal life of Jamaica

These Indians, the Arawaks, were an agricultural people, of peaceful disposition but continually harassed by the cannibalistic Caribs who frequently descended upon them from the sea, and who had in fact driven them from the South American mainland to seek a refuge on the islands. Because of their fear of the Caribs it would appear that the Arawaks kept a lookout seaward from the well-concealed caves to be found in many places along the coast. Also it was their practice to bury their dead in caves, and in our excavations it was a common occurrence to turn up human bones. Sometimes, if the cave was an ample one, charcoal and bits of pottery showed that these primitive people had feasted in the caves, either at a time when they were hiding from the enemy Caribs or possibly as a funeral rite. Always to be found in these ashes were the bones of the rodent *Geocapromys,* and it is from this fact, I was told, that the animal gained the name of Indian cony. It is the one native land mammal living on the island today, bats excepted, and until about 1900 it had an extensive distribution and was a favorite food item with the Negroes.

Because it has been preyed upon by the mongoose and also constantly hunted, it has been gradually killed off, and at the time of my arrival upon the island I fully expected to learn that it was extinct. At the Institute of Jamaica, in Kingston, however, I found a live one in captivity and was told by Mr. Frank Cundall, the librarian in charge of the Institute, that the species was still to be found in the John Crow Mountains, on the eastern end of the island. I therefore planned a side trip into these mountains to obtain a few specimens for scientific work in the American Museum. Through the courtesy of the United Fruit Company we were enabled to spend about ten days on their large plantation at Windsor, near Port Antonio, and about nine miles from the heart of the John Crow Mountains.

The Indian cony is a robust rodent, with a body the size of that of an ordinary house cat, but with a very short tail. It is almost exclusively nocturnal. The local name given to it by the Maroons, those Negroes who live in the Jamaican hinterland and claim descent from the runaway Indian and Negro slaves of centuries gone by, is "grazee," having reference to its habits of feeding on grasses and the leaves of low shrubs. It seeks shelter for the day under the roots of some large tree or far back under huge limestone bowlders, and is found at present only in the roughest situations. We learned that to obtain any specimens and to observe anything of the animal in life it would be necessary to climb up into the fastnesses of the mountains and spend a night or two "in the bush" while we hunted the cony with dogs. A local magistrate, Mr. Massey, kindly made the necessary arrangements for a hunt, and with five men and numerous small dogs we started for the upper John Crow Mountains. After a long climb up slippery trails we at last came to an opening in the forest where a palm-thatched shelter had been erected for the convenience of hunting parties. It was early afternoon, and there was yet time for some hunting, so we left certain of the men to dispose of the packs, build a fire, and put the shelter in readiness for the night, and with six small dogs struck off into the forest.

We were at about 1200 feet elevation on the western slope of the mountains, and although the forest was fairly thick it was yet possible for one to leave the trail and work his way through the "bush." The dogs disappeared almost before we were out of sight of camp, some of them going on up the trail ahead and others taking off into the brush at either side of the trail. It was an overcast day, and it had rained several times while we were coming up into the mountains and now, under cover of the primitive forest, it was very dark and gloomy and there were no bird calls to break the stillness. Before we had gone very far the two natives stopped and loaded their single-barreled shot-guns, first inserting a shell loaded with number six shot, and then dropping down the muzzle a heavy slug of lead which they held in place over the shot by ramming down a wad of paper or leaves. I learned that this was in preparation for wild hogs, which were likely to prove disagreeable customers if they were encountered at close quarters on the trail. The mountains of Jamaica in the wilder, more remote sections, are the haunt of a great many of these feral swine whose ancestors escaped from domestication more than a century ago. The boars grow large tusks and show an inclination to use them, so the natives pay this animal considerable respect.

As we were crossing a small stream, one

of the dogs that happened to be following at heel made a sharp swerve to the right and began a diligent search among some bowlders and old logs. His actions had been noted and we waited to see the outcome. Very shortly he set up a wild, excited yelping and began to dig away in a frenzied manner at a large hole that ran back under a huge bowlder. The Negro hunter with us became almost as excited as the dog, and ran back across the stream to help dig out the cony. With his machete he soon cleared away the fallen vegetation, and when the hole was sufficiently exposed he was able to pull out a few fragments of limestone that blocked up the entrance and this allowed the dog to get his head and shoulders inside. The dog had been impatiently waiting for this to be done, and as soon as the man's hands were withdrawn, he plunged into the hole and by dint of much struggling was able to worm himself in until only his tail protruded. Then we heard a faint birdlike chirping in the intervals when the dog drew breath for a fresh outburst of barking, telling that the dog and the cony were face to face, and almost immediately the sound of snarling and worrying. When the hunter heard this, he reached in and seized the dog by the hind leg, dragging him out by sheer strength.

The dog had secured a firm grip so that the cony was dragged out into the open, where it was promptly seized by the hunter before the dog could tear it. The cony possesses sufficient vitality to withstand a great deal of mauling, and can put up a good fight. This one had bitten a small piece out of the dog's nose. Not infrequently several animals are taken from the one hole, and we put the dog back to see if he could find any more, but he soon backed out with the disgusted expression that showed that the place had no further interest for him, so we moved on. In this case the dog was of rather good size for this type of hunting; generally speaking, the smaller the dog, the more it is prized by the Negroes, because it can enter the holes more easily.

Less than a hundred feet down the stream one of the other dogs now gave tongue to a shrill yelping, and dogs and men went pell-mell to give assistance. This hole was a much more difficult proposition than the other, and I did not see how there could be any hope of enlarging it, as it ran under huge blocks of limestone weighing tons. The dogs, only three of which were with us at this moment, were indulging in the wildest antics at the entrance, scratching frantically and lying on their sides in the effort to take up as little room as possible and squeeze into the cavity. From this great display of

The Indian cony (*Geocapromys brownii*) is a heavy-set little rodent with coarse, reddish brown fur of no commercial value. The natives are fond of cony flesh, and roast the singed animal whole much as if it were a small pig. The particular cony of the photograph was snared at the mouth of its burrow by a native who had learned that there was a temporary market for live conies while the American Museum Expedition was in the neighborhood

A BANANA PLANTATION ON THE MOUNTAIN-SIDE

Thousands of acres of land in Jamaica are devoted to the cultivation of bananas. The orderly rows of plants extend even into the mountains, for the soil there is very fertile and the rainfall heavy. This photograph was taken in the Blue Mountains on one of the holdings of the United Fruit Company at Windsor, where the members along the mountain ... The Blue Mountains rise above the valley to a maximum height of 7300 feet. Great masses of puffy white clouds ...

A HUNTING PARTY WITH CONY DOGS

The Negroes are enthusiastic hunters in the John Crow Mountains, and stop at nothing to capture a cony when it has been located. The dogs—poor, half-starved mongrels for the most part, whose ribs stand out with pitiful distinctness—show an unbelievable intelligence in pursuing the game, and are adept at worming into a small burrow. The tall staff held by one of the men is a sharp spear for wild hogs which are sometimes encountered on the trail. The photograph shows in the background a mountain shelter built for the use of hunting parties eagerness the two hunters concluded that the cony must be very near the entrance and consequently should be easily reached. Digging with a machete loosened some of the rock and earth at the entrance, and then a large bowlder was encountered that seemed to defy further progress. Also one of the dogs had squeezed through, and was crowding against the bowlder with such impetuosity that it seemed certain he would try to dash past if it were loosened by hand, and would be crushed by its weight. However, the men would allow nothing to stand between them and their quarry and the two of them crawled halfway under the big overhanging limestone bowlders, and while one held the obstructing bowlder from crushing the dog, the other loosened it and rolled it out of the way. That was the conclusion of the chapter. There was the same procedure of dragging out the dog and taking the rodent away, and we had secured two specimens of the Indian cony for our first hunt.

The next morning dawned in the midst of heavy showers, and it was ten o'clock before we could take the trail. Mr. Falkenbach stayed at the camp to get the packs in readiness for our return that afternoon while I took three of the natives for another try at the conies. Soon a chorus of barkings and yelping from several dogs made us think that the pack had run across wild hogs, and the hunters forthwith scattered out to command the several trails in that immediate neighborhood, but when the commotion seemed to be stationary it was concluded that the animals were barking at a cony hole. Abruptly the chorus was changed to angry snarls and yelps of pain, and the hunters called out that the dogs had caught a cony and were fighting over it among themselves. We hurried to the spot, but we were too late. Only a torn up bit of forest floor showed where the fight over the feast had taken place. When we arrived on the scene the dogs were all back at the hole, which was under the base of a huge tree that sent out wide-spreading roots.

One of the dogs had crawled so far under these roots that his barking was muffled and barely audible, and his presence could only be guessed at, since no part of him was visible. Another dog had entered under a different root and was threatening invasion from a new angle, but had not been able to get so far. A third dog stood outside, near a very small burrow that ran up the axis of a root, and after barking a few moments until his worked-up emotions could not be restrained any longer, he would reach down and bite long splinters out of the root and then thrust his snout into the opening to draw long, audible sniffs of the quarry-tainted air. Still other dogs ran aimlessly about the tree, barking or trying to shoulder one another away from advantageous spots.

It was only after an hour and a half of digging by four men and six dogs, that the cony was reached by means of a bit of strategy. The rodent had been located approximately by the action of the dogs, and occasionally its chirping call note could be heard. Two particular dogs were called into service and the others were forcibly kept in the background. The hunters loosened the earth and enlarged the hole as much as possible and put in the larger and stronger dog. With one long, ecstatic sniff for location the canine pushed vigorously in as far as the space permitted, and then lying over on one side scratched loose and dug out considerable amounts of soil. After he had dug thus for a while he was drawn out and the smaller dog, called Fanny, was allowed to enter. She got so close to the cony that her excited yelping threw the dogs outside into the greatest excitement. The quarry, however, seemed to be able to keep just out of reach, although obviously its line of retreat was rather restricted. The old Maroon had been digging in from the side above where the cony seemed to be located, and suddenly he called out that he had touched the animal. About that time Fanny came to grips with a very angry cony that proved to be more than a match for the little dog. Amidst snarling and chirping, and an accompaniment of great anxiety on the part of the outside dogs, which had all been tied on leashes and were being held, Fanny tried to back out of the hole with the cony, but he broke away and disappeared.

Each man was now anxious that his own individual dog should be put in to finish the job, but the unquestioned leader of the pack, Captain, was finally set free. There was an energetic scuffle inside and as soon as one of the men could catch a leg of the dog he was dragged out, and this time the cony did not escape. The entire proceeding had been exciting from the very

MARKET PLACE AT A CROSSING OF MOUNTAIN TRAILS

Market day in the Blue Mountains near Cinchona is a popular event in spite of the difficulties in transporting produce to an elevation of 5000 feet. There are spread out for sale all sorts of ground provisions, such as yams, yampes, cassava, sweet potatoes, cocos, and cho-chos, together with fruits—bananas, plantains, oranges, and grapefruit—and a few chickens and eggs. Most of the commodities are carried up the mountain on the heads of the natives, although some are transported in hampers loaded on the backs of donkeys start, well worthy of some larger game, and the energy and intelligence displayed by the dogs were out of all keeping with their appearance, for they looked to be worthless, half-starved mongrels.

Another collecting trip was that made into the Blue Mountains, when a week was spent at Cinchona, at an elevation of five thousand feet above sea level. It would be difficult to find scenery more beautiful than that visible from the summits of the Blue Mountains. Here, however, scarcely any material was obtained, and the evidence collected was all negative since nothing but the introduced species, the house rat and the mongoose, are found there. Traps were set to confirm this supposition and caught no native mammal.

Only too evident were the ravages of the mongoose seen in the disappearance and approaching extinction of many forms. The mongoose was introduced in 1872, in order to keep down the rats which had been a great menace to all crops. It was not brought to Jamaica to kill off the snakes, as many people seem to think, for no venomous snakes have ever been found in Jamaica. At first the mongoose proved a great success, rapidly thinning out the rats until the rats learned that the only safety for them was in an arboreal habitat, and they became tree dwelling. The mongoose does not climb, and consequently the rats soon became as numerous as before, and a greater pest than ever since they were up in the trees and not so easily destroyed. A new phase of the disturbed cycle of Jamaican life now was manifest. The mongoose, deprived of a rat diet, turned upon all the other small forms of animal life with an even greater intensity, and soon made great inroads upon the ground-nesting birds and upon the lizards, frogs, and toads. These animals had been contributory to the keeping down of numbers of the cattle ticks, and with their diminution the ticks began to increase at an alarming rate. It is said that the mongoose was susceptible to the ticks and suffered greatly in consequence; at any rate the animal died off in great numbers and for many years was just able to hold its own. Now, however, its numbers have increased until it is no uncommon thing to see three and four daily, and they range from the seacoast to the very summit of Blue Mountain Peak.

Collections of reptiles and birds were made, although these were necessarily small for lack of time to cover all the branches of vertebrate zoölogy. An iguana (*Cyclura*), the largest lizard known on the island, was especially desired since this is one of the animals that have disappeared with the introduction of the mongoose. It is now known only on Goat Island, a small island in Old Harbour just off the main island and to which the mongoose has not yet penetrated. Two trips were made to Goat Island, and on the second attempt an iguana was obtained.

The people of Jamaica are greatly interested in all that pertains to their island, and any effort to increase the knowledge of the early history of Jamaica meets with a ready coöperation. Members of the American Museum Expedition met with a helpful interest everywhere, and no small part of any success achieved is owing to the generous assistance of the residents.

The interest in West Indian zoölogy has been growing yearly, and more and more attention is being directed toward the solution of the several big problems connected with the study of this subject. The accumulation of evidence is growing apace, and among the fascinations of such a trip as the one to Jamaica is the possibility that some constructive advance may be made. For who can tell what the storehouse of fossil treasures may yield?

Rock Rivers

By VERNON BAILEY

Chief Field Naturalist, Bureau of Biological Survey, United States Department of Agriculture

WE are familiar with the terms "rock slide," "slide rock," and "talus" applied to the masses of broken rocks which lie on the steep slopes of the mountain-sides, usually below some peak or cliff from which they have fallen; but such names seem inadequate for the more extensive and active of these moving masses. "Rock rivers" and "rock glaciers" they have been called.

Sometimes the rocks are fragments thrown from the mouths of craters and left sliding down the steep outer slopes; frequently they have been broken by various forces from the face of a cliff or high peak; again, they have been washed over a precipice by water or pushed over by ice. Usually they are the slow accumulations of broken rocks on steep slopes, or they are piled so high against the mountain wall that they have steep outer slopes of their own. Their form and action can be shown with a handful of pebbles or sand.

Rock slides, we say, lie at the angle of stability, which means that they would have visible motion if the angle were any greater. The angle of stability varies considerably with the size and nature of the rocks and the character of the surface on which they lie. Some that I have measured with a clinometer registered from 26 to 36 degrees above the horizontal, but at this angle there is no real stability.

On one little volcanic cone near San Francisco Mountain in Arizona I climbed laboriously for more than two hours to reach the crater rim only 1000 feet above me, and came down again in about ten minutes by taking fifteen-foot strides in the loose scoria that slid with me all the way to the bottom.

On the sides of Mount Shasta there are many sliding slopes of fine, loose rock where ascent is difficult and descent rapid and easy; also many extensive slopes of heavier slide rock where ascent is easier and descent slower, because the weight of a person is not sufficient to set the mass in rapid motion. Still there is motion, constant or intermittent, often with many of the accompanying phenomena of a stream.

In form these streams generally resemble glaciers more than rivers, starting from a definite source and reaching down, fanlike, over broad, steep slopes for a few hundred or a few thousand feet, or sometimes for a mile or more. A broad slope may carry many such streams of rocks from different sources, which join and blend into one great mass that widens below until checked by striking another slope or by reaching a lower angle.

One such slope photographed near Riverside in eastern Oregon is composed of broken blocks of basalt from an old volcanic neck which rises 700 feet above the

Illustrations from photographs by the Author.

SLOWLY MOVING RIVERS OF BROKEN ROCKS

A broad slope down which flow many streams of broken rocks, from a basaltic butte in eastern Oregon. Tongues and islands of sagebrush cling here and there and at the base a ridge of soil and sagebrush is pushed up where the rocks bury themselves in the ground

THREE VIEWS OF ROCK STREAMS

Side view (at the left) of a broad expanse of sliding rock below the cliff of a lava butte in eastern Oregon, showing moderate steepness of slope.

A detail (photograph in the middle) of sliding slope, showing ripples below the points of rock that stand above the surface of the stream.

Head of the Kiger Gorge (at the right) in the Steens Mountains of eastern Oregon, a wonderful cirque, eaten out by glacial ice on a northeast slope at about 9000 feet elevation, now a sliding mass of talus below the base of the cliff valley bottom. On this slope are seven well-defined channels which partly join and reach the bottom in three main rivers. Each of these streams shows some trace of curves, deep pools, shallows, rapids, and islands, and some show cascades or falls. A striking evidence of activity in one of these streams is the terminal wave where the rocks plunge into the mellow soil with such force as to push up a ridge of sagebrush-covered earth often twenty feet high, suggesting the last ripple of a stream meeting the ocean tide.

In rate of flow these rock rivers are probably slower than the ice rivers, or glaciers, but I am not aware that their speed has ever been measured. They must vary greatly with the angle of slope, the depth, the nature of the material, and the disturbing elements. Although they move with great force, under enormous pressure, the motion may be only an inch, a foot, or a rod a year; or from a sudden upheaval they may rush from source to terminus in a few moments.

After climbing over hundreds of these sliding slopes in the Rocky Mountains, Sierra Nevada, Cascades, and, best of all, in the desert ranges of the Great Basin region, I heard with keen interest John Muir's interpretation of their origin and dynamics. This was on a pack trip in the Sierra Nevada in 1900, when he often discussed mountain structure with us around the camp fires and along the trails. An earthquake witnessed in the Yosemite Valley when showers of rocks thrown from peaks and cliffs went thundering to the valleys below had solved for him the problem he had been studying—the origin of the Sierra talus.

One of the main interests in these rivers is the force producing them. There is always a source, generally a peak or cliff or ledge high up, from which the rocks keep slowly breaking away and falling, rolling, or sliding down to add their arrested momentum and force of gravity as they increase the surface angle of the stream. The forces which break off and start the rocks are many beside earthquakes and volcanic eruptions. Heat, frost, ice, snow, water, wind, thunder, and lightning are among the disturbing elements. The forces that keep them from remaining where they fall are all of these and many more. Heat swells and cold contracts them, the vibrations of the thunderstorm pass through them, rain loosens their props, snow presses them down, ice lifts some and pushes others aside, rain and hail pelt and tilt them, mountain sheep, goats, marmots, and chipmunks run over the surface and rock and roll them, and every change, every motion, however minute, is down, down, down, under the resistless force of gravitation. The weight of millions of tons pressing downward in a single stream of rocks is the great moving force, just as it is in a stream of ice or a stream of water. Put your ear to the surface of the rocks on a hot day. You can hear them creak and groan and sigh—the faint, low roar of a mighty torrent. When the earthquake shakes them and they go rushing and roaring downward, this is the flood time of the rivers of rocks.

The animal life of these streams is also of interest. Mountain sheep and goats make trails across them; rock conies find safe homes in the innumerable cavities under the surface and stack their hay for winter food under the shelter of the rocks; woodchucks and, in the north, great hoary marmots dive under the rocks to escape their enemies; chipmunks scamper over the rough surface or dodge underneath for safety; wood rats, white-footed mice, and many others of the small rodent tribe find safe retreats in their depths; rock wrens are often found bobbing and singing on the rocks; and high above timber line the rosy finches build their nests well back in the protecting niches under the rough slopes. To many of the feeble wild folk they are a wall of protection.

Plant life is scattered and scant except for mosses in the shaded nooks and lichens over the exposed surfaces of the rocks. These minute, scalelike plants usually cover the exposed surfaces of rocks that have remained quiet for a long time, but gain only a slight hold on those freshly broken from the cliff or those occasionally moved or turned over. So slowly do these plants grow that, as Muir has pointed out, they form a general index to the time a rock has lain in one position up to probably fifty or a hundred years. To a certain extent the speed of the rivers may be judged by these plants; the rocks of the steeper, more active slopes show fewer rock lichens, while those of the lower, quieter slopes are more heavily covered with these humble but by no means insignificant plants.

New Plans in Nature Extension Work[1]

By GEORGE H. SHERWOOD

Curator of Public Education in the American Museum of Natural History

THE American Museum carries on explorations in many countries, far and near. Its explorers study these lands, their people, and their native plant and animal life both of today and of the millions of years past. Then it displays freely in great exhibition halls all that it has discovered, so that everyone may see and know.

It has tried from the beginning of its history to make itself, here in the great eastern metropolis of America, a fountainhead of knowledge of the earth and the sea, and of man and all the other forms of life which have evolved on the earth. The doors are open every day in the year; there are guides and instructors for the exhibits, and lectures for all—even for the blind; there are great mural paintings of ceremonies and industries of ancient peoples; homes of animals are represented with such exact reproductions of nature that flower and tree and bird seem living; there are motion pictures of hunting and adventure, games and homes, work and play, in foreign lands. And the people of New York come to see all these things, and the children come in whole schools or classes, or voluntarily in small groups with their school-books under their arms or their roller skates swinging from their shoulders. The record has reached nearly a million annually for several years.

But the American Museum is always asking how it can do more to bring its wealth of original knowledge to the people. There are many in all ranks whose lives might be enriched in some way—made happier, gentler in nature, less self-centered, more resourceful, more valuable in their community—even more prosperous, perhaps, we can add, in these days of correlated science and industry. Especially would the American

[1] HISTORICAL NOTE.—There has just come from the press of the American Museum of Natural History, in the series of its Miscellaneous Publications, a small book, *Free Nature Education*, by Mr. George H. Sherwood. This is a report which gives the present status of the Museum's instruction to the teachers and children of the New York public schools in the Museum building, located in what is now about the heart of New York City, and also tells the story of the extension of the institution's teaching and resources out into the schools.

The staff of lecturers for 1919 included, besides the members of the regular department staff, men of experience in exploration, as Dr. E. O. Hovey, of Arctic interests, Mr. N. C. Nelson, especially known for his excavations of ancient ruins of the Southwest, and Mr. James P. Chapin, who spent seven years in the field and jungle of the Belgian Congo.

The history of the pioneer work in nature education by the American Museum is divided into two periods, in the first of which (1869–1904) lectures to adults were given at the Museum and a few small collections were deposited in the public schools; and in the second (1904–1919) a system of lectures to children was inaugurated, of guide service to the exhibits, of special instruction to the blind, and most important, a system of circulating loan nature study collections and loan sets of stereopticon slides. Today many advances force themselves upon attention and the work is entering a third period of very great educational activity.

There is much coöperation with industrial art, especially through the Museum's department of anthropology. This means affiliation with the work of such institutions as Teachers College, Hunter College, Cooper Union, New York School of Fine and Applied Arts, Ethical Culture School, School of Applied Design for Women, and Pratt Institute. Special rooms are set aside for the use of designers. There are rooms also made available for the public school teachers and their classes with equipment of blackboard and stereopticon. The work with the blind especially has reached a high development. There are regular classes for about one hundred fifty blind children, and the Museum is in touch with about seven hundred adult blind who are reached through special lectures. Among the lecturers have been such men as Sir Arthur Pearson, of England, and the late Admiral Robert E. Peary.

In reporting on the extension work of the Museum in its newly inaugurated plan for Local Lecture Centers, Mr. Sherwood emphasizes the need for larger collections in the selected schools:

"Our present circulating collections are doing important work, but more effective results would be obtained if the teachers might have available a more extensive teaching collection. For this reason it would seem desirable to establish a Branch Teaching Museum in a number of centrally located schools. The teachers of the district could then draw upon this material as required. The material could be changed periodically, perhaps three or four times a year, corresponding to changes in the course of study. The Branch Teaching Museum should contain not only representative specimens of the animals that are being studied but small portable groups illustrating relations to environment."

The following statistics of the report are of interest:

The number of schools in Greater New York supplied in 1919 with circulating collections were 385, reaching nearly 900,000 pupils. The lectures to school children given during 1919 number 90, with a total attendance of about 50,000. The separate loans of slides number 1470, including a total of 80,000—THE EDITOR.

Museum spread the knowledge and happiness of nature before the million children of Greater New York, whose thoughts are continually cramped and warped by their more or less sordid surroundings into channels not healthful or idealistic for youth.

To attain this greater breadth of result three new plans of Museum extension are in mind in definite form, two already initiated and the third in immediate prospect. All are methods, of course, of taking the Museum's work to other centers of dispersal than the Museum building on 77th Street and Central Park West. We must now carry nature to the children instead of depending entirely on their visits to the Museum, which have become increasingly difficult with the great growth of the city and the complexities and expense of transportation over the long distances.

The first new plan concerns the establishment of various schools as Local Centers, situated within easy reach of given other schools, so that the children can walk the intervening distance. At these centers American Museum study collections will be kept permanently, and distributed as traveling collections to the teachers of the surrounding schools. Also the chosen school becomes an American Museum Lecture Center. The lectures in no instance take the place of the teacher's work, but instead correlate and supplement it, giving an enriched background for understanding and appreciation in the regular classroom study. Three schools have been created Local Lecture Centers, important among them being the Washington Irving High School, but the system must be extended to other districts just as soon as funds are available for the purpose. Eventually the plan should entail a small permanent museum for each school. Thus the centers would become in truth transplanted vital parts of the mother institution.

The second line of extension is perhaps the most fundamental and important of all plans so far attempted. It consists in carrying a knowledge of the Museum's resources to the classes of teachers in the training schools. There are three training schools for teachers in Greater New York. We have inaugurated the work in only one of these so far, with lectures by the members of the Museum faculty on "Africa," "South America," "Animals of the Past," and the "Beginnings of Life." But surely we contribute to the source of successful child education in New York City when we make these young teachers at the beginning of their work realize by personal experience the interest and value of what the American Museum can give, and if we make them know that they can always get, merely for the asking, this background for their geography or history or literature classes later. They have but to ask for lectures, ask for slides, and they will be delivered free at the schools, or ask for guide or instructor for their classes when they come to the Museum.

These two plans represent work in coöperation with officials and teachers of the public schools of New York City where the American Museum takes the initiative. The third should be expressed as a desire rather than a plan and entails coöperation with existing educational activities where the Museum does not take the initiative. I refer to the work of such organizations as the School Nature League, organized and carried on under the inspired leadership of Mrs. John I. Northrop. The Museum will help in every way possible here, in appreciation of the extremely high character of the work in those parts of the city where such influence is particularly valuable. I refer also to the work in Visual Instruction under Director Ernest L. Crandall. This again is a case where the Museum strongly desires to get behind and help push—its institutional pride being satisfied merely in a furtherance of the good work. Fortunately, this subject is one in which the institution's experience, as in the matter of scientific moving pictures, may prove of practical value.

Historic Trees in America

Relative to the future and the past, and introducing a recent book of accuracy and charm, the "Historic Trees of Massachusetts" [1]

Our historic Boston Common.—"Probably no other spot in the United States has seen so many thousands of men recruited for military service . . . or so many millions of dollars contributed for the cause of human liberty." None of the trees on the Common today is of primeval origin. All have been planted, and range between one hundred and two hundred years of age. The two greatest were "Liberty Tree" and the "Great Elm." The former was destroyed in 1775 and its place is now marked by a memorial table. The Great Elm was the native king of the Common and full-grown about 1722. It was destroyed in a gale in 1876

TO the memory of American soldiers of the World War many thousands of trees have been planted in America during 1919 and this spring of 1920—in groves, along drives, and as individual monuments. The trees are more or less spindling, and do not bear out their impressiveness of meaning; but the greater number have been planted by children, and trees may grow to great size within a human lifetime. In fact, trees may grow to a very considerable height, sometimes nearly fifty feet, in little more than one half a lifetime. So the boys and girls who have planted these mere slips of trees may some day be proud that through their own personal initiative there came into existence such commanding historic monuments.

America has also many ancient trees, of vast dimensions, which have escaped destruction. Fortunately we have even bits of primeval grove and forest left, and thus can know how these young trees of today will look when they have attained to full or late maturity and give shade for the play of children three or four hundred years from now. We cannot deem it strange that man venerates trees when nature has ordained that just a common oak or pine shall live so many times as long as he!

When we read Mr. Simmons' book on the historic trees of Massachusetts, it is as if we walked in memory over Indian trails and Colonial roadways of the years prior to the Civil War. We review stirring events of our early national history. Under the canopy of the elm at Cambridge we proudly greet Washington as he takes command of the American Army. We extend cordial welcome to Lafayette in the shade of that great elm on the road to Palmer where he rested on his way to join Washington. We pass under the five-hundred-year-old oaks, red and white, at Wayside Inn in the town of Sudbury, where the ancient trees give up memories of Washington and Lafayette, and of Longfellow in the century later. We inhale the fragrance of the great pine on the road to Lenox—the same fragrance that delighted Oliver Wendell Holmes so many years ago.

The effect is as if these trees which witnessed the scenes and were there to hear the voices had themselves spoken to us. We put aside the book with a new reverence for trees as living monuments, more fitting than marble or stone to commemorate individual heroism or momentous national event.

And we have become ambitious to plant young trees in some heroic connection, so that they shall be started with a fresh glory upon them into the long and noble career ahead. We are ambitious to honor, under auspicious circumstances which will link them forever with the history of America, the great trees of today. We would bring from obscurity in various parts of the country into the light of appreciation the many unknown trees of historic and human interest. We would send candidates to an American "Hall of Fame" for trees.

[1] *The Historic Trees of Massachusetts.* By James Raymond Simmons, secretary of the New York State Forestry Association, formerly assistant state forester of Massachusetts. Illustrations from photographs by the Author. On the front and back inside covers of the volume is printed a road map of Massachusetts, which locates about forty historic trees for the convenience of automobilists

THE WASHINGTON ELM AT CAMBRIDGE

Great trees, survivors beyond the allotted span of human life, remain the only living witnesses of the events of other generations, and are especially revered as historical or personal memorials by the children's children of those who contributed to their renown. Among the most notable events of the Republic's birth was the assumption of command of all the colonial forces by Washington on July 3, 1775, in the presence of his general officers and troops under the branches of a great elm of the Cambridge Common. This elm, one of the remnants of the primitive forest, is more than 18 feet in circumference and was once nearly 100 feet high and 90 feet in spread of branches

OLIVER WENDELL HOLMES'S PINE

Remnants of the primitive forest, giant white pines are now rare in New England, for they are not naturally so long-lived as the oaks and other hardwoods and are too much in demand by the lumbermen, but the lone pine on "Canoe Meadow" near the old road to Lenox was a favorite of Oliver Wendell Holmes and probably of his father's father. This pine is large for New England—97 feet high and 16 feet, 4 inches in girth—and is unique among Massachusetts conifers in the spread and density of its branches for the tall pines of the remaining virgin forests are likely to have long tapering boles with only a few tassels of green needles at the top

TREE PILGRIMS TO PLYMOUTH

Foremost among the living associates of one's homeland are the trees of the forest and roadside. The English have always been proud of their oaks and lindens so the early colonists brought these tree friends to maintain associations with the homes from which they had broken—and, as it chanced, to give the species permanent place among our native flora. These eight lindens were planted by Colonel George Watson who commissioned a Boston sea captain to bring them to America. They bear an inscription dated 1760, and have stood for a century and a half against the storms of the Plymouth coast

A LIVING WITNESS FROM THE COLONIAL WARS

The crowning beauty of old Deerfield, perhaps New England's quaintest and most beautiful town, is in its elms, maples, and buttonwoods which line the streets and hide the ancient houses, many of which date from the Indian wars. This buttonwood stands near the spot where stubborn defense was made against the French and Indians in Queen Anne's War and must have been passed by Captain Thomas Lathrop when he undertook to rescue grain in Deerfield from King Philip's Indians, perishing with his men in the attempt. The tree is now 18 feet in circumference and 100 in height and spread

WHITE OAK—THE BUILDER OF SHIPS

There was a time when the white oaks of New England were among the most important shipbuilding materials of the world, for oak wood is long enduring in ships as well as when part of a living tree in the forest. In 1797 the Avery Oak just escaped going into the timbers of "Old Ironsides" (still lying at anchor off Charleston) for the consideration of seventy dollars. This tree antedates the town of Dedham, on whose seal it appears, and still stands four-square against the wind with only a scar from lightning. It is traditionally reported that the first religious meeting of the town was held under its shade

A CENTURY OF APPLE BLOSSOMS

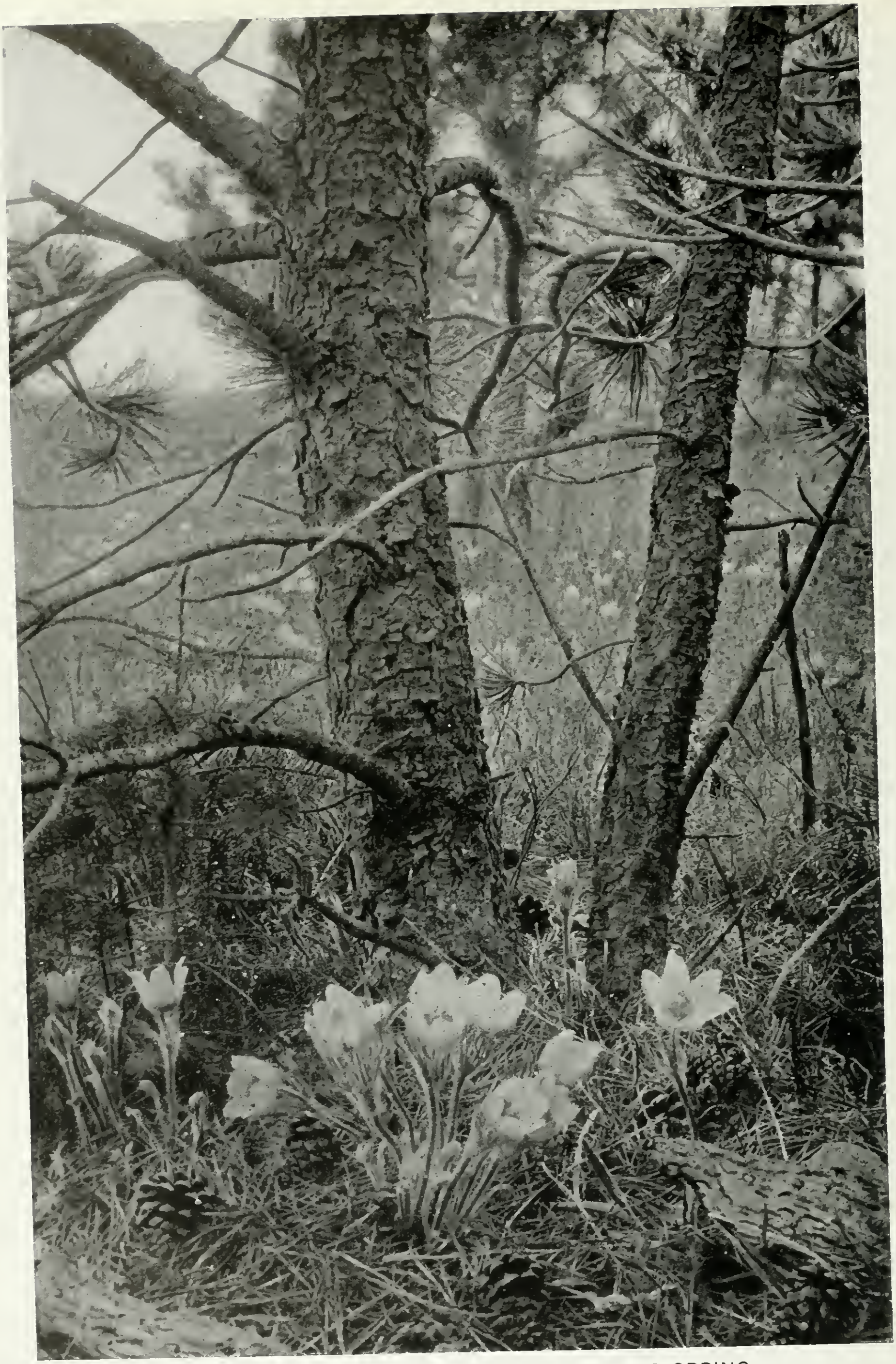
An apple tree with an age more befitting that of an oak and with a spread of branches equaling that of a giant elm is noteworthy among trees. The apple tree at Marshfield Hills on Cape Cod Bay is more than one hundred years old and presents in spring a sixty-foot ball of white and pink blossoms supported by limbs nearly six feet in girth

WITH ASSOCIATIONS IN HISTORY AND LITERATURE

The trees of Concord are haunted by connections with the stirring events of 1775 and by the peaceful associations of American literature. Groves and shade trees have from time immemorial been immortalized as the companions of authors who walked or thought, or conversed with nature and friends, beneath the branches. In the house under these elms Louisa May Alcott once lived, and within the deep shade of the pine grove a bowlder informs the visitor that Nathaniel Hawthorne "trod daily this path to the hill to formulate as he paced to and fro upon its summit his marvelous romances"

ANCIENT OAKS BY THE WAYSIDE INN

At Sudbury, west of Boston, is Longfellow's "Wayside Inn" where "Through the ancient oaks o'erhead. Mysterious voices moaned and fled." Ancient even in Longfellow's day, the two oaks—red and white—already dominated the roadside when Washington passed in 1775 on his way to Cambridge to take command of the army, and later when both he and Lafayette stopped at the inn. The poet frequented this famous inn and there found inspiration for his "Tales of a Wayside Inn." The trees are at least 500 years old; one is now hollow but has been braced from within so that it gives promise of ruling for many years among the numerous descendent oaks sown from its acorns in the surrounding fields



PURPLE PASQUE FLOWERS OF A COLORADO SPRING

Hunting with a camera requires as much cunning and patience and endurance as hunting with a gun—a fact which has probably been a potent factor in developing the great interest in nature photography in this country during the last few years. With a camera the true sportsman may indulge his delight in the out-of-door world and his interest in the wild animals and native plants of our country without sacrificing life and beauty in the pursuit. Wild flowers are among the daintiest but by no means the easiest subjects to photograph, because time exposures are necessary for fine detail, and careful work to bring out the true color values. See detail study on page 187

Ground squirrels are endowed with curiosity and large appetites, which fact makes them excellent subjects for the photographer if only he brings a bag of corn. This stocky little Say's ground squirrel (*Callospermophilus lateralis*) is commonly mistaken for a chipmunk, which it closely resembles in marking and habits (See also page 189)

Trials and Tribulations of a Nature Photographer

By ROBERT B. ROCKWELL

Member of the Colorado Mountain Club

TO the casual reader, a well-taken "nature photograph" is merely a picture—of no particular significance beyond the subject it depicts, but to the one who has spent strenuous hours in pursuit of elusive outdoor subjects, it represents far more than the image on the paper before him. One must take an actual part in the game and experience its hardships and accidents, as well as the brilliant flashes of good luck and unexpected success, to appreciate fully the fact that a really good picture of this kind is the result of patience and persistency conquering disappointment and failure. And to this very fact may be attributed the remarkable increase of interest in nature photography which has characterized the last few years in America. For the American sportsman is one who loves God's great outdoors, who glories in a battle of wits with God's wild creatures; and the nature photographer is a sportsman who is quick to recognize in photography the possibility of indulging these fancies without sacrificing life and beauty in the pursuit.

Nor can he who has spent long, freezing hours in a November duck blind, or dragged his weary limbs over miles of fallen timber after deer or bear, contend that his alone are the hardships; for every obstacle which presents itself to the man with the gun has its counterpart for the man with the lens and plate; and as the value of a trophy on the den wall is measured by the effort that secured it, so is the charm of a good picture dependent upon the reminiscences it calls to mind.

One of my first yearnings in the line of nature photographs was for a picture of my pug-

Illustrations from photographs by the Author.

These five-weeks-old Rocky Mountain screech owls were prize portrait sitters because of their great glowing yellow eyes and their alert, fearless manner and comical ultra-dignity, but considerable differences of opinion as to pose and background had to be settled between them and the photographer before this picture could be snapped

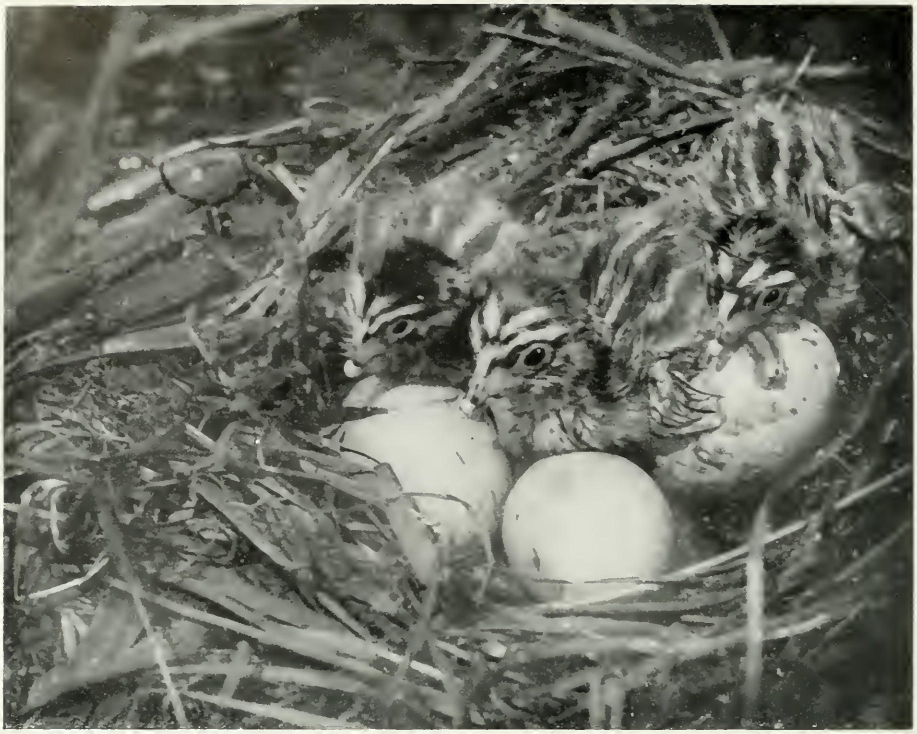
nacious little friends, the screech owls, and as I had been much in contact with them for several years in connection with nature study and had held many of them in my hands, I anticipated little trouble in obtaining the coveted portraits. So I took trip after trip and exposed dozens of plates, but the results were uniformly unsatisfactory. His "owlship" would not "smile," or else he persisted in keeping his great yellow eyes tightly closed, or a wandering zephyr blew his soft feathers awry; be the cause what it may, my collection of owl pictures grew amazingly in number, but improved not at all in quality. Until at last—oh, happy hour!—I came upon a nest which I had overlooked on my earlier trips, and brought to light from the hollow tree two wide-eyed, scrappy youngsters, almost fully feathered and ready to tackle in mortal combat anything from a mouse to a grizzly bear. We had a spirited argument regarding questions of pose, expression, and background, but in the end, after several heart-breaking races through the dense underbrush and up a couple of trees, and with my two hands covered with scratches and cuts, the owlets agreed (?) with me perfectly on all points under discussion; the exposures were made, and I triumphantly bade them Godspeed, with what eventually proved to be the coveted pictures tucked into my camera case.

Among my particular ambitions was one to take a good picture of a nest of young grebes. Now, be it known, a baby grebe takes to the water almost as soon as it leaves the shell in its floating nest, and thereafter its moments on *terra firma* are few and far between. So when the proper time came for baby grebes I sallied forth with the big camera and plenty of determination. After a seven-mile tramp over a hot, dusty road I arrived at the scene of action—a small, rush-bordered pond—and immediately began operations. I was not long in locating a favorable nest, and judging from a multitude of tiny squeaks, I surmised that the youngsters were near at hand. After considerable search my eye at last fell upon the first one, all submerged except the point of his bill, and looking exactly like a bit of mud. The second one was hauled forth from under a cat-tail stalk; the third one had crawled under a bit of green moss; and so on, until eight tiny striped babies filled my hat with squirming chaos.

Standing in the stagnant water to my waist, holding my hat full of prizes in my teeth, and fighting a multitude of mosquitoes with one hand while I endeavored to set

Screech owl nestlings have outlandishly big "noses" and large, ungainly feet, forerunners of the formidable weapons they will wield as adults

Pond residents such as the grebes test the persistence and endurance of any man who enters their watery habitat with his desire bent on pictures. The low, floating nest of the American eared grebe is a shaky affair resting on the water and débris of small rush marshes, usually unanchored, and subject to the vagaries of wind and rain. Often the old bird, before leaving the nest, covers the eggs with grass and reeds



Young grebes leave the nest for the water very soon after they come out of the shells, so photographing them in their pond home is a labor of hours. The above picture was taken after a lively scramble with the young birds, but unfortunately the photographer, carrying his camera, stepped into a muskrat hole on the way to shore, after which the plates were somewhat the worse for water and the photographer for pond scum, mud, and various minute living things more delectable to grebes and fishes than to picture hunters

up the camera with the other was, to say the least, rather engrossing work. The slender legs of the tripod no sooner touched the soft ooze under foot than the camera sank to the surface of the pond, and in my wild scramble to avert a dire calamity my focusing cloth dropped into the water and was dragged forth a reeking, ill-smelling mass of green moss and tiny creeping things. At last, the preliminaries being completed, I dumped the babies into the nest, and presto! eight black streaks radiated in eight directions from the nest, with the photographer trying to follow in all eight directions at once. The Marathon runners think they know what "endurance" really means. They should try — just once — to keep eight baby grebes in a nest when those babies hear the call of the wild, and they will readily see what a tame performance a Marathon race is, in comparison. But then, there is a limit to the endurance of even a baby grebe, and at last eight very tired youngsters were safely ensconced in the nest, indifferent to my efforts to pose them. Oh joyous moment! The dreams of many a winter evening were finally realized! The light was perfect, the background all that could be desired, and the water as smooth as glass. I exposed plate after plate and dreamed of the series of grebe pictures soon to be mine. Finally, my last plate was exposed, the holders stuffed into a hunting-coat pocket, and the tramp to the shore begun, when with a mighty splash I stepped into a muskrat hole and sank out of sight, plate holders and all. My negatives ruined! All my fond hopes blasted! And seven miles to more plates! Did I return to take those pictures again? I refuse to answer.

The sight of that tall, silent sentinel, the blue heron, has never failed to arouse in my heart a great longing for his portrait, but years of study had satisfied me that he was an impossible subject. Imagine my delight when, upon a visit to a nesting colony of these great birds, I saw high up in a tall cottonwood a full-grown young of the year, whose actions plainly showed that he had not yet mastered the gentle art of flight.

A nerve-racking climb under a broiling sun and in the stench of the rookery at last brought me to where I could dislodge the bird from his perch, and with set wings he sailed clumsily to the ground, to be pounced upon immediately by my eager companion. Then began a strenuous test of wits, speed, and endurance, for our new-found friend was wild and clever and quick, and could run like a deer. Our ideas and his regarding bird portraiture were entirely at variance, and his opinions were invariably backed up by his actions, so that it became necessary to follow him at breakneck speed over two or three hundred yards of burning sand each time he changed his pose. At last, however, he came to the mature conclusion that *one* bird cannot run down *two* picture fanatics, and the desired exposures were made, the results of which not only fill my soul with joy to this day, but impress upon me the fact that I should have been a professional foot racer.

In direct contrast were the actions of two young black-crowned night herons, which, while they exhibited the modesty that befits all well-reared birds about to be photographed, were so amenable to reason as to allow their photographs to be taken without the usual accompaniment of speed contests.

One of the fascinating features of nature study lies in the fact that the most unusual experiences with birds and animals frequently occur under the most unexpected circumstances. Many an arduous day of keen disappointment, fruitless search, and stupefying fatigue in the field is immortalized in the student's memory by some unlooked-for discovery or delightful glimpse

The striped spermophile (*Citellus tridecemlineatus pallidus*), or "gopher," is a true prairie dweller, frequenting the arid plains east of the Rocky Mountains and seldom entering the timbered areas. We may see it almost anywhere in this region as it darts through the grass to one of its ground holes. Remain quiet for a few minutes, and it will soon reappear, with little black eyes peering out inquisitively. The spermophile depends for protection on a burrow two inches in diameter and from fifteen to twenty feet in length; the tunnel descends suddenly at first, but never more than one or two feet below the surface. In the fall, soon after the first few frosty nights, the spermophiles disappear for the winter among their stores of grain and seeds

THE SPERMOPHILES HAVE LEARNED THE FINE ART OF POSING

When startled, the striped spermophile may "freeze," standing upright on its hind legs, straight and motionless as a tent stake or a picket pin for which it might easily be mistaken. One can then approach to within a few yards before the little animal will drop on all fours and disappear into one of its numerous holes, chattering a long drawn out "chur-r-r-r" in a high key

WILD FLOWERS GATHERED AND TAKEN HOME—BUT NOT DESTROYED

American pasque flowers (*Pulsatilla hirsutissima*), often known as "anemones," blossom abundantly in dry soil among the foothills and mountains of Colorado, adding their purple to the many brilliant colors which make the spring beautiful in that state. As shown in the photograph, they blossom before their leaves appear. This group of pasque flowers was photographed on the low ranges west of Golden, but the species grows as far up as the limit of trees (See also page 180)

into the home life of some wild creature, long after the last vestige of hope for success has departed. Such an experience befell the writer one June day.

A trip was made to the Barr (Colorado) chain of lakes for the purpose of photographing bird life and comparing its abundance and variety with that of several years previous, at which time the writer had done rather extensive field work in the same locality. The Barr chain of lakes (or, more accurately, ponds) is a series of small rush and cat-tail bordered bodies of water forming a part of a large irrigation system, and caused by the seepage of a large reservoir lying at the head of a broad flat valley. The large irrigating canals supplied by the main reservoir form a line of demarcation between the dry, brown, almost desert-like prairie above the ditch and the fertile, brilliant green fields below, where the magic touch of water has converted the parched plain into an agricultural paradise.

The spot chosen for our operations was a rather extensive piece of low, marshy ground, lying between three ponds, where in previous years we had found a wonderfully diversified and abundant bird life, but on this trip our hopes were early dashed away. A few short years had worked sad havoc with this favorite nesting ground. A prairie fire had converted the wealth of cat-tail swamp into a dreary brown waste; a herd of peaceful cattle had effectively tramped out the spots where formerly birds nested by hundreds; a large drainage ditch had converted into rich, dry farming land acres of what had been ideal environment for thousands of our feathered friends.

The great colony of nesting black-crowned night herons and Forster's terns had disappeared. The wild ducks had found less disturbed surroundings, and the only familiar creatures were a number of killdeers voicing their deadly monotonous cry, an occasional red-winged or yellow-headed blackbird, and hosts upon hosts of ravenous mosquitoes and deer flies which drove us promptly into head nets, gloves, and bad temper.

The day wore on with terrific heat, increasing fatigue and disgust, but with very little in results, until, in crossing a small grassy patch, we were greeted with the peculiar musical, subdued "mumph" of a Wilson's phalarope. Hours of fruitless search on many previous occasions had proved the futility of hunting for the wonderfully concealed nests of these charming birds, so that their appearance upon the scene, although exhibiting every well-known evidence of having a nest near by, did not arouse any great hopes in our disgruntled frame of mind.

Imagine our surprise and delight then, when within a few moments of the bird's appearance we discovered the three brownish, black-mottled eggs cozily ensconced in a cunningly fashioned nest tucked in the short grass at our very feet—the indistinct mottled appearance of the eggs blending so perfectly with their surroundings that we hardly dared to take our eyes from the nest for fear of losing it.

The battery of three cameras was hastily unstrapped, tripods erected, and long strings attached to the shutters, at the other ends of which we concealed ourselves and prepared for the tiresome vigil, with decided misgivings as to whether the timid parent bird would return to its treasures with three huge black cameras glowering within a yard of the nest.

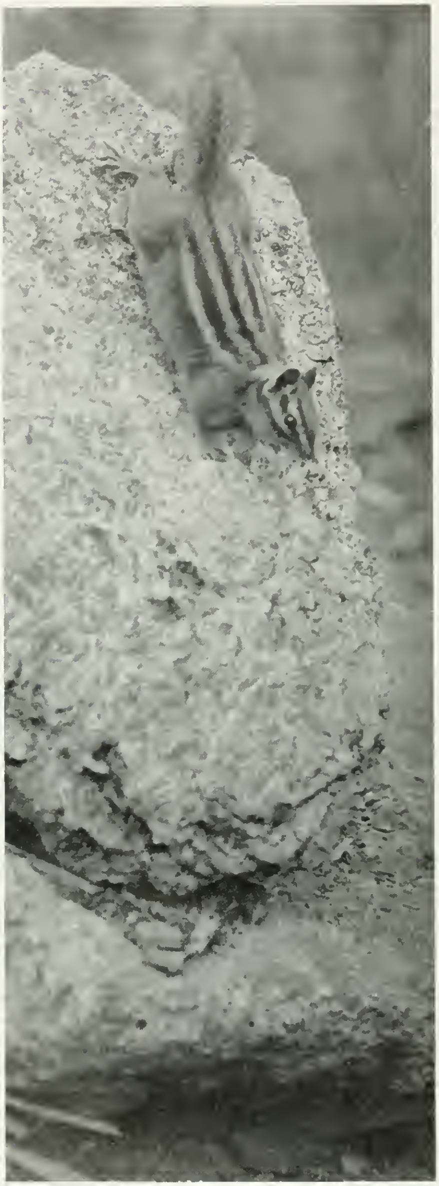
To our surprise, within a minute or so the bird, which had been circling about us in the air, uttering its peculiar stifled note of alarm, alighted a few yards away and began skulking through the grass toward the nest, making every effort to keep its whereabouts concealed from us. A tense minute followed, terminated by a low whistle from the observer nearest the nest. At the signal three strings were pulled, three shutters clicked, and three exultant enthusiasts rushed toward the nest, happy in the thought that the much-desired negatives were theirs.

At the click of the first shutter the bird hurriedly flushed from the nest with every evidence of panicky fright, and we supposed that our picture-taking was at an end. But again we were treated to the surprise of our lives, for, even as we were changing our plate holders—all three of us close enough to lay our hands on the eggs—the brave little creature lit within a dozen yards of us and began warily to circle about us in the grass.

Silence and absolute absence of motion are the first lessons the student of wild creatures must learn, so we "froze" in the most approved manner. Round and round us the dainty little bird slipped, its every sense keenly alert, its bright black

"AT HOME" TO THE VISITING NATURE PHOTOGRAPHER

Say's ground squirrel is a characteristic mammal of the open yellow pine and fir forests in Colorado. It lives in rocky ledges, among piles of bowlders, in hollow logs, or digs a burrow for itself under the shelter of logs and rocks. These burrows have several entrances and exits within a small area for quick escape from enemies above ground or below (Photographed near Grand Lake, Colorado)



The Colorado chipmunk (Say's four-lined squirrel, *Eutamias quadrivittatus*) has its center of abundance among the yellow pines of the Rocky Mountains. It is the largest and best-known of the chipmunks of the state, and is commonly seen among the eastern foothills as it frisks about the rocks in the early morning or late afternoon, uttering a quiet "chuck, chuck." With a little patience the photographer may easily catch this chipmunk in a good position for a picture; it possesses great curiosity and is always ready to investigate the man with the camera. The Colorado chipmunk hibernates throughout the winter months in the northern part of its range

eyes snapping with excitement, and the pretty head gracefully dipping from side to side with apparent curiosity and uncertainty, yet, withal, with very little evidence of fear.

Crouching over our cameras in the broiling sun, with no opportunity to assume comfortable positions and with an army of hungry insects ferociously attacking us, we hardly dared to breathe or wink our eyes. Slowly—oh, so slowly—in its circling progress it approached the nest. In our tense, strained position the short minutes seemed like hours. Several times our little friend nearly reached the nest, only to be overcome with a little panic of fright, when with a startled note it would scamper away a dozen feet and we would groan to ourselves. Finally, just when our muscles and nerves were at the breaking point, the bird suddenly took heart and, gliding swiftly forward, settled itself over the eggs, daintily ruffled up its feathers, preened them for a moment with the long slender bill, and then gave its entire attention to watching us. A breathless moment followed, during which we waited for the nervous little head to stop bobbing back and forth,—then the shutters clicked, three more wonderful negatives came into existence, and away went our bird.

Surely this last harrowing experience would be more than any timid bird could endure! But no! We were about to witness what few naturalists even of lifelong experience are privileged to see.

Within a few moments our little bird was back and we were treated to the experience of seeing the instinctive timidity of a wild creature overcome by parental devotion to the nest. Although it had twice been frightened from home by three terrible monsters, the strong instinct to cover and protect the three treasures overcame its terror, and back it came, again and again.

This remarkable opportunity for close observation of the Wilson's phalarope brought to light many interesting peculiarities of the brooding bird. It was apparent that the long legs were much in the way; in fact, some moments were spent after settling upon the nest in moving about and turning this way and that in an endeavor to assume a comfortable position and at the same time keep the eggs adequately covered.

The extreme rapidity and the constancy of motion upon the part of the bird even when sitting on the eggs were surprising and are most clearly demonstrated by the fact that of the negatives made, although our fast shutters were adjusted for the shortest exposures, only two or three were perfectly sharp in every detail of the bird.

Of the many times the bird flushed from the nest, not once did it spring directly into flight, but in each instance ran a step or two before taking wing; yet so extremely rapid were all its movements that at a distance of twenty feet the observer would not realize this fact.

The prize subject of our outdoor photography, however, was a young gopher, which was encountered one Fourth of July on a sandy flat, with the temperature ranging upward to 100 degrees. "His Nibs," as we promptly named him, was apparently possessed of a gnawing hunger and a remarkable capacity, for, during the half day we spent in his charming company, the amount of corn (placed there to give him an interest in the proceedings) which disappeared from about the entrance of his burrow would do credit to a work horse. We photographed him coming out of the burrow, going into it, sitting up, lying down, "meditating," and in various other positions, and the eighteen pictures of that poor overworked little gopher are in themselves an index of his moods and fancies.

The rarest opportunities for good pictures often come at the most unexpected times. Near the end of a cruelly hard day's tramp which had been entirely barren of results, my eye was caught by a bit of color almost at my feet, and there lay a perfectly beautiful specimen (if you can imagine such a thing) of the blue racer. He lay entirely at ease, his brilliant coils glistening in the afternoon sun, a "pose" one could not have secured by hours of patient work. A moment of breathless focusing, two careful exposures, and the deed was done. Result, two pictures that would fill the heart of a snake charmer with delight; and the entire operation did not take five minutes.

Not the handsomest, yet one of the easiest of nature subjects is that bluffer, the bull snake. Ferocious in appearance, size, and in everything but fact, he imagines himself as terrible to the photographer as to the baby birds upon which he feeds, and the practical absence of fear of mankind

The nocturnal beaver is not a good subject for the camera, but its carpentry is much in evidence in any region where this hard worker abounds. Beavers spend their nights in and about the water, felling trees, building dams, erecting their houses, and storing short lengths of branches on the bark of which they feed during the winter. Sometimes, as shown here, they attack the farmer's fence post; their instinct does not tell them that they cannot carry it away. Since the beaver has been protected in Colorado, it has multiplied favorably and is to be found even within the confines of Denver. The photograph was taken on the South Platte above Brighton, Colorado makes him easy to approach and handle. The only obstacle to be overcome is that he is so very long and so very narrow, he does not always fill the plate to the best advantage.

Among the most difficult subjects are the insects. Because of their small size it is necessary to take them at very short distances (usually less than a foot), and this so limits the field of the lens that only boundless patience will catch the subject in exactly the proper spot at the right instant. Their quickness makes very fast exposures imperative and nothing short of the finest equipment in lenses and shutters is capable of satisfactory results.

The daintiest of all subjects—the wild flowers—are not nearly so easy to photograph effectively as one would think. Time exposures are necessary for the finest detail, and the tiniest breeze starts the pretty heads waving in a manner wholly exasperating to the man under the hot focusing cloth. Furthermore, true color values are more or less difficult to secure and most of the work must, of necessity, be done very close to the ground if the flowers are to be photographed *in situ:* but, as in the other cases, the results more than compensate one for the labor, and the trophies are a constant source of joy.

Among the easiest and most satisfactory subjects are birds' nests. The surroundings of the nest usually furnish beautiful settings, the light can be controlled by means of screens, and best of all, the subject will not run or fly away while you are preparing to photograph it.

Many species of young birds are ideal subjects. Young flickers, when carefully handled, are especially tractable and can be posed in the desired setting with comparative ease. Humming-birds are also easy to photograph when around their nests. They have little fear of human beings and soon become accustomed to the close proximity of the formidable-looking camera.

In conclusion let me say to you, my fellow lover of the wildwood, try the sport of photographing your friends of fur and feather if you want real sport. When you approach a wild creature with a gun, you approach it as a deadly enemy, and in your effort to bring it to bag, you overlook the individuality of your quarry, its whims, peculiarities, and characteristics, but when you approach it with a camera, you come as a friend, and even the wild things are quick to recognize the difference. You will come into closer comradeship with the things that creep, run, and fly, than you ever dreamed possible. You will look upon the outdoors with the kindly eye of the friend instead of the cold eye of the life-taker, and you will return from the hunt with trophies as hard to secure, as highly prized, and as valuable and lasting as those of any Nimrod that ever lived. But you must enter the game with determination, grit, endurance, patience, and the inherent love of the earth's wild creatures without which no one can succeed in nature photography.

We discovered a Wilson's phalarope (*Steganopus tricolor*) by accident near Barr, Colorado. The species is common on the shores of marshes throughout the prairie region, but a search for the nest is usually without result, so skillfully is it hidden

South American Field Notes

With special reference to the habits of two species of birds, the jabiru and the rhea

By GEORGE K. CHERRIE

South American Field Collector and Ornithologist

IN OUR ascent of the Paraguay River[1] perhaps one of the most striking birds we saw was the giant stork, or jabiru, which, until we made this trip, I had thought rather an uncommon bird in South America. Along this river, however, we saw actually thousands of these birds—and seeing them reminded me of my first experience in collecting jabiru.

I was at that time in the employment of the Museum of the Brooklyn Institute of Arts and Sciences, and the director, Dr. Frederic A. Lucas, was very anxious to secure specimens of this stork, as there had then never been a complete skin or skeleton in any of our museums. Accordingly, an expedition was arranged which had as its primary object the obtaining of specimens of jabiru.

On some of my previous trips I had seen an occasional jabiru in the Orinoco Valley, and knowing that country very well, I decided that I would go back to the Orinoco region and make my search for jabiru. After I had made my way up into the interior above Ciudad Bolivar, the real search for the storks began, and for about three weeks I hunted just about as hard as it is possible to hunt,—that is, I tramped daily across the open plains, and made my way through the bushes along the water courses, and through swamps and marshes. But all was of no avail—there were no jabiru to be found.

Then I arranged an expedition from the little town of Caicara back toward the hills on the borderland of British Guiana. Three days' journey from Caicara we made a stop at one of the outlying cattle ranches, Las Guacas, on the San Felice River near its union with the Cuchivero. Here, the second morning after our arrival, as I was wandering along the shores of a great marsh, I espied a jabiru on the opposite side, fully five hundred yards away. I wanted that jabiru, and I wanted it badly. At the time I was using a sporting Mauser 30-30 rifle. I lay down on the ground, put in a metal jacket bullet, and took very careful aim at the bird as it stood quartering toward me. At the report of my gun the bird went down.

The next problem was to get my game. To go around the big marsh meant an hour, or perhaps two, of tramping through the broiling hot sun. During that time some animal, one of the larger hawks, or possibly a vulture, might destroy the specimen. The idea of losing it I would not even consider after my long hunt. So the only thing to do was to wade, or swim, across the marsh to the place where the bird had fallen. I removed my clothing, laid my gun carefully on top of it, and, wading most of the distance and swimming where necessary, I reached the opposite shore and saw the bird lying before me, the white of its wings spread wide on the grass of the marsh. Then suddenly, without any warning, the bird started to get to its feet. It attempted to open its wings, but was unable to do so. I instantly realized that my bullet probably had passed through the body and had at least broken both wings, so I thought that in any case the jabiru was easy prey. Then the bird started to walk away from me. I increased my pace; the jabiru took steps just a bit longer. Presently the jabiru was walking at a good lively gait, and I was running as fast as I could. I knew just how ridiculous a sight it was.

Finally I had to give up, the bird simply "walked away" from me; and there was nothing left for me to do but return, cross the marsh as best I could, get my clothing and my gun again, and take up the hunt for jabiru once more. I might add, perhaps, that a few days later I was more fortunate in securing specimens, which were later brought north, and now form an exhibit in the Brooklyn Museum collections.

On the Roosevelt-Rondon Expedition we saw also, as we ascended the Paraguay

[1] The Roosevelt-Rondon South American Expedition, 1913–14, AMERICAN MUSEUM JOURNAL, February, 1915.

River, a good many nests in trees that stood isolated from other forest growth, sometimes near the river bank, and again well back in the open or *campo* country. On the original Roosevelt expedition, 1913–14, we obtained only two specimens, and the time at our disposal was too short to make any extended observations as to habits. On the supplementary trip,[1] however, in the interior, at Fedegoso, Matto Grosso, several nests were found within a radius of about three miles from our camp.

One of the nests contained half-grown young, and I was much interested in their behavior when the nest was discovered. At my approach the two young birds, which had been sitting quietly side by side in the nest, got to their feet and began walking around and around the great platform of sticks that formed the nest. As I came closer, they came to the side of the nest nearest me and indicated their displeasure at my presence by viciously snapping together the two mandibles. Then they walked gravely around and returned, still continuing to snap their mandibles. This they kept up for nearly an hour; then one of the old birds appeared on the scene.

As the parent bird alighted on the nest, the two young birds immediately crouched down. The mother was evidently much annoyed; she snapped her mandibles together as the young birds had done, but in her case it was a more decided and vigorous performance. All the time she was on the nest the young birds remained quiet. Apparently this was a case where young folk were supposed to be seen and not heard.

From the natives I learned that the nests of these great storks are often used year after year by the same birds, which never leave the immediate district where their home is located. Jabiru nests are usually placed in very large trees isolated from other forest growth, and consist of a great platform of dead sticks (these sticks are often three and four, and sometimes five feet in length, and as much as an inch and a half in diameter). I found one exception in this character of environment. One pair of birds had built their nest in the center of a group of nests of the wood ibis, picking out, I think, the tallest tree, and placing the nest in the extreme top of the tree. From this station the parent birds could overlook the entire colony of wood ibis, and also have an unobstructed view of the country all about. In the crevices between the sticks of quite a number of jabiru nests which I saw, were built the nests of small birds; and the common green parrakeet (or as I think it should more properly be called, "the apartment-building parrakeet") very frequently used the bottom of the jabiru's nest as a foundation from which to build downward its nest structure containing many apartments.

We left Descalvados, on the Paraguay River, and at the end of a two days' journey eastward across the Panateles, reached one of the outlying cow camps, known as "Fedegoso." Stationed here were half a dozen cowboys, and there were two small ranch houses as a protection against the rains. The camp was located in a part of the country that is under water for probably at least six months in the year, but at the time we reached there it might almost have been described as in the center of a desert—as far as drinking water was concerned. The six cowboys obtained water for household purposes from a shallow pond perhaps a hundred feet in diameter located quite near the ranch house. Into this pond the men, when returning from a day's ride, would usually take their horses, carefully bathe them, less carefully bathe themselves, and then dip up a sufficient quantity of the same water for drinking and kitchen purposes. There was no other water within many miles of that camp. As a consequence, the water we drank there was usually boiled, and boiled pretty vigorously. Also we had to flavor it with tea or coffee; but even in that way we were unable completely to conceal the disagreeable taste of decaying vegetation.

There was, however, some compensation for having to live in such a camp. For instance, in the neighborhood wild rhea were frequently seen, sometimes not more than fifty yards from the camp, and as long as there was no movement in the camp, the birds remained apparently unconscious of our presence.

One day an old male rhea came out into the open to exhibit his flock of from twenty to thirty young, a most interesting sight. The parent bird would keep his head lowered for about fifteen seconds, rarely

[1] "To South America for Bird Study," Cherrie-Roosevelt Expedition (1916), AMERICAN MUSEUM JOURNAL, April, 1917, pp. 269–273.

longer, then he would stretch his neck to its full length and look in every direction over the open plains. The flock of young followed closely at his heels, and on one or two occasions there was probably some warning sound or sign given, because we could see the young birds squat down and lie motionless until the old bird again gave the signal that danger was past.

On another occasion, when riding quite near this camp, we discovered a family of young rhea, perhaps not more than a week, or at most, ten days old. We were anxious to obtain a number of young to be used in the building of a museum group showing characteristic bird life of the Panateles, so we determined to ride down some of these young birds and capture them. But it was much more easily said than done. We put spurs to our horses and galloped just as hard as the animals could go toward the old rhea and his charges. We did gain on them, but it was a slow, hard race, and just at the last moment when we thought we were on the point of reaching our goal, the young rhea disappeared as if by magic. A few minutes previous they had been scattering farther and farther from one another, and perhaps at the last the old bird had given the signal to disappear. In any case, every bird was gone—of course lying flat somewhere, with its neck outstretched, as we had before seen them. But we searched an area of perhaps a hundred yards and thought we walked over every foot of the ground, yet not a single young rhea did we find. An hour later, when we came back to the same neighborhood, we saw, in the distance, the old male hurrying his flock of young toward a belt of timber which would offer even better concealment than the open where they had evaded us.

The males, the careful guardians of the young, were not always so successful, and at Fort Wheeler, in the Paraguayan *chaco,* I succeeded in getting young rhea. They were much more wary than were those about Fedegoso. There for several days I had noted old birds which at a distance looked very much as though they were accompanying young birds, but not until early October was I successful in getting any for the Museum. One morning, as we were riding, in open country in which there were many clumps of trees with thick undergrowth offering admirable protection for birds and other animals, we saw an old rhea. Ordinarily the males, and the females also, when alarmed keep to the open and depend on their speed for protection, but this fellow, the moment we came in sight, made a rush for the thick woods. We hurried after him as fast as possible, hoping that he would skulk along the edge of the forest.

Courtesy of Leo E. Miller

From one of these rhea eggs twelve persons may be served a breakfast that furnishes the necessary nutrition and satisfies the palate. Natives sometimes find single eggs scattered here and there over the ground, but usually they rob the nests, which hold eggs deposited there by various female rhea to be incubated by the male. The eggs of the most common species are bluish in hue; others have a yellow tinge

On reaching the margin of the woods we stopped and listened, and heard the plaintive calls of young rhea. We had not suspected that there was a family with this old bird. Noting the direction of the sound, we immediately plunged into the forest, regardless of torn clothes and lacerated hands, and forced our way through the underbrush. Very soon we caught sight of the old male as he rushed back and forth from side to side, at once urging and encouraging his charges in their flight, and at the same time endeavoring to lead us off the trail. Every few moments he would flap his wings in a way that produced a peculiar rustling sound, no doubt a signal to the young birds to hurry, and at the same time he would emit peculiar little gruntlike sounds. Apparently most of the young were being driven ahead of their protector. A few, perhaps the weaker ones, were falling behind; and it was the desire of the old bird to protect and succor these that led to our discovery of some of the poor little chaps. Two of the weakest ones had been caught in a tangle of briers of the kind known in New England as "beggar-lice," and were held prisoners there. Others we caught in a wild scramble through the woods.

As soon as we caught one of the young birds it would seem to submit, but did we loose our hold ever so slightly the little thing would free itself with a quick jerk and the race was on once more. We hadn't brought with us on that particular day anything in which we could carry a dozen lusty young rhea, but my Indian guide took off his cotton shirt (and I am sure that he felt more comfortable without it), tied a string about the bottom of it to form a bag into which we thrust our birds—and they are now all awaiting their preparation to form part of the group that will show young America a bit of wild life from the Panateles.

It is perhaps worth while to record another little incident regarding the rhea's ability to conceal itself. One day I was riding through the tall grassland, my Indian companion only a few yards behind me. I rode close to a little clump of trees and looked from right to left as I passed them. After we had gone about a dozen yards, my Indian friend approached me with a "Hist!" I turned my head and looked. He did not speak a word, but motioned back of him. I didn't know what he had seen, but I knew something interesting was there. He led me back to within perhaps ten yards of the foot of the trees which I had just examined so carefully. For a moment I saw nothing; then it slowly dawned upon me that something was outlined on the ground. I approached cautiously a little nearer, and gradually realized that what I had taken for a bowlder was a male rhea covering a nest of eggs. The body of the bird was drawn as closely to the ground as possible, with the neck stretched straight forward on the ground. There was not a movement even when I approached to within a dozen feet of the bird. But at the click of my camera the old fellow sprang to his feet and dashed away across the open plain. Before me lay a nest of thirty-seven eggs. The nest itself was only a slight hollow in the ground. To me the most interesting thing was that, for a radius of about six feet, the tall grass had been carefully cropped, and the grass itself used as a nest lining. My Indian guide explained this habit of cropping the grass by the fact that very frequently at this season of the year, when the grass is very dry and inflammable, fires are started that sweep mile after mile of the open country, over and around many nests of the rhea. By cropping the grass the rheas are able to save their nests from destruction. My guide even insisted that frequently the male rhea sticks to the nest while a fire sweeps around him. Personally, however, I should not like to stand sponsor for that statement.

During the laying season, rhea eggs are frequently found scattered here and there in the open. Such eggs are, of course, never incubated, but they add very much to the food supply of the Indians who wander about over these plains. The Indians, and also all of the ranch owners and cowboys of this region, use not only the eggs of the rhea, but very frequently also the flesh of the bird. The latter I tried upon one or two occasions and, while I believe that careful preparation would improve it, yet I should hardly recommend it. The plumes of the rhea are, of course, marketable everywhere throughout the region the bird inhabits, and the Indians employ the skin as well, tanning it as they do the skins of mammals, and making it into bags and receptacles of all sorts.

THE BROWN PELICANS

A SERIES OF PREVIOUSLY UNPUBLISHED PHOTOGRAPHS OF THE BREEDING BIRDS ON THE LOUISIANA GULF COAST, WITH NOTES ON THEIR HAUNTS AND HABITS

BY ALFRED M. BAILEY [1]

A GRAVE AND STATELY ASSEMBLAGE

One half the brown pelicans found in the United States live along the Louisiana Gulf Coast, and the irregular shore line, cut as it is with innumerable bays, dotted here and there with small islets, is an ideal habitat. There are no coral reefs, but great mud bars stretch from little islands of sand, and the deep bayous which extend far back into the low coastal lands pour a flood of muddied waters into the shoal places in which the pelicans like to dabble.

The greater number of the sea birds nest on the little mangrove islets of the Chandeleur chain, the inside islands of Breton and Mississippi sounds, and those extending westward to Timbalier. The Mud Lumps and Chandeleur have the chief pelican colonies. The Mud Lumps are at the mouth of Pass á l'Outre, the easternmost pass through the delta of the Mississippi, and are about twenty in number, varying from a few yards to a few acres in extent. The vegetation is scant; nightshade and a few coarse grasses grow sparingly. Some of the smaller lumps have not even a blade of grass. In fact, all the islands are so densely packed with birds that vegetation could not grow abundantly. After several trips to the islands with various naturalists, and taking the average of our estimates, it would seem that not fewer than fifty thousand pelicans congregate—all of them in sight at one time!

Fortunately these sea birds are now protected by fed ral and state coöperation. Poachers no longer interfere with them to any great extent, and patrol boats are kept constantly in the vicinity by the State Department of Conservation

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[1] These observations and photographs on pelicans and a series on terns which will appear in the May–June issue of NATURAL HISTORY were made by Mr. Bailey when he was a member of the scientific staff of the Louisiana State Museum. At present Mr. Bailey is a member of the United States Biological Survey at Juneau, Alaska. A previous article by Mr. Bailey on the water birds of Louisiana appeared in NATURAL HISTORY, Vol. XIX, pp. 45–72.

THEY DELIGHT TO SPORT IN THE MUDDIED WATER

The colonies on the Mud Lumps are well protected by nature, for they are above the highest tides and harbor no carnivorous mammals. The large mangrove keys, however, are differently situated. Grand Cochere, in June, 1918, had twelve hundred nests of pelicans. In July only a few hundred nests remained, owing to the ravages of raccoons. In June, 1919, two feet of water covered the whole island. Raccoons and storms cause the greatest loss to the bird colonies. Rows of birds' eggs may often be seen where the waves have washed them into depressions.

The pelican is a surface feeder entirely, for although it dives downward through the air, it rarely disappears below the surface of the water. During the breeding season brown pelicans feed almost entirely on a bony sardine unfit for human consumption. This fish is so abundant in the warm, shallow waters that a much larger bird population could be supported without endangering the food fish supply of the people (See NATURAL HISTORY, Vol. XIX, pp. 41–43, concerning investigation of the food of the brown pelican)

STICKS FOR THE NEST ARE ALWAYS AT A PREMIUM

Brown pelicans gather pieces of sticks and fashion a crude nest on the ground in April. The nests first built occupy the outer islands and are better prepared than those made later in the season, when only picked-over material is to be had. By June, if the old birds desire to keep their house intact, they must guard it continually, for the other nest builders have no compunctions about removing the houses from around the young birds. Battles are waged constantly and invaders routed with snapping of beaks and flapping of wings. The pelicans crowd on the outer islands until standing room only is available; then they gradually fill in the islands nearer the shore—which are likely to be occupied by raccoons also

PARENTAL INSTINCT

Three chalk-white eggs are deposited soon after the clumsy nest has been formed, and in time three naked, black, "india-rubber" birds feebly beg for food. The young birds grow rapidly, and the white down increases until the whole rookery is clothed in white. The young are constantly attended by one of the parents, especially at the earlier stage, and shielded with drooping wings from the direct rays of the sun. Soon, however, they leave the nest and go blundering about the island, joining in every "free for all" where chances for food seem at all favorable

AT MEALTIME IN THE PELICAN WORLD

Feeding the young takes place at all hours of the day, but there seem to be two regular mealtimes. In photographic work I found the chances poor for getting feeding pictures between eleven and three. The whining young bird anticipates the arrival of the parent several seconds. Therefore, when a bird grew particularly noisy, I hastily focused on it. It is almost impossible to get a good picture when several of the three-fourths-grown birds attempt to feed, because there is such a tangle of wings and legs. The youngest unfeathered pelicans make the most interesting subjects to photograph. They are so feeble that they can scarcely balance themselves, and when reaching upward to get the fish, are completely enclosed in the parent's pouch. Their tenacious disposition is admirable; they stubbornly insist on trying to swallow a fish larger than themselves until some obliging neighbor waddles along and removes the temptation

Charles Gordon Hewitt—In Memoriam

Biographical notes and an appreciation of the character and achievements of the late Dr. Hewitt by the Commission of Conservation, Ottawa, Canada

IN the death of Charles Gordon Hewitt, Dominion Entomologist and Consulting Zoölogist of the Canadian Commission of Conservation, the biological sciences have lost a leader of exceptional ability. Not only was he held in the highest esteem by his colleagues of the Dominion Entomological Service, but entomologists generally the world over appreciated his brilliant attainments and marked executive ability. Although eminent in entomology, his studies were by no means confined to this science. A broad survey of economic zoölogy from the national standpoint occupied a large share of his thought particularly during the last four or five years of his life.

During Dr. Hewitt's eleven years of office he developed the Dominion Entomological Service from a very small division attached to the Experimental Farms Branch, to an important separate branch of the Department of Agriculture. This was his most important achievement and the organization he perfected will remain a tribute to his great ability and zeal. The breadth of growth of the Entomological Branch is instanced in the establishment of important divisions at Ottawa, such as the Division of Field, Crop, and Garden Insects, the Division of Forest Insects, the Division of Systematic Entomology, and the Division of Foreign Pests Suppression, all under the immediate direction of highly qualified chiefs. In addition to these divisions of the work, special officers have been placed in charge of such lines of study as Natural Control Investigations, Insecticide Investigations, and Stored Product Insect Investigations. In the various provinces, too, field or regional laboratories have been established, with trained entomologists in charge who study local problems and disseminate information of value to agriculturists, horticulturists, lumbermen, and others.

In 1909, Dr. Hewitt recognized the importance of legislation to prevent the introduction or spreading of insect pests and diseases destructive to vegetation, and as a result of his efforts Parliament, in May, 1910, passed the Destructive Insect and Pest Act. Under the regulations of this Act inspectors were appointed to deal with the threatened spread of the brown-tailed moth in the Maritime Provinces, and provisions were made for the prohibition, fumigation, or inspection of nursery stock at definite ports of entry. In addition to the brown-tail scouting work, which he developed in co-operation with the provinces of Nova Scotia and New Brunswick, he arranged for the collection in Massachusetts and establishment in eastern Canada of thousands of parasitic and predacious enemies of the brown-tailed and gipsy moths. Dr. Hewitt was keenly interested in medical entomology and accomplished much useful work on problems related to the house fly, mosquitoes, ticks, and other species which spread disease.

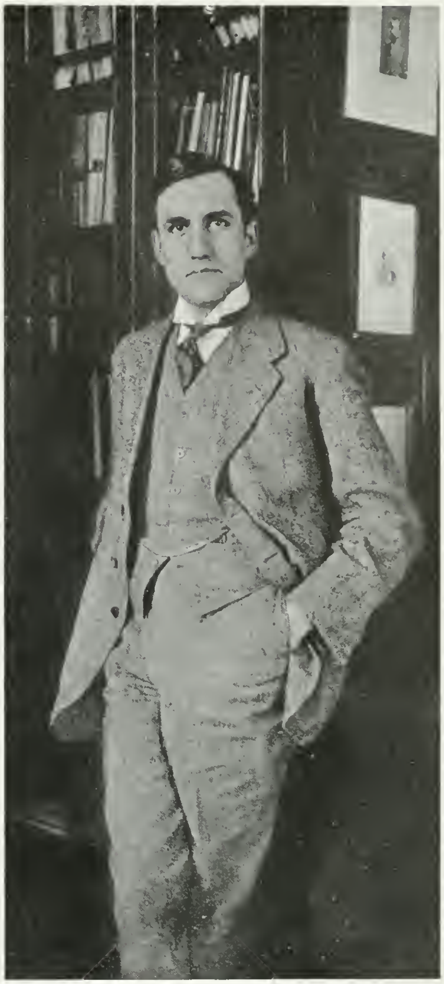
He was the author of important books and memoirs. His chief published work is the well-known book on the house fly of which there were two editions. A smaller book on the same subject appeared later as one of the Cambridge Manuals of Science and Literature. His departmental publications consist of a series of annual reports (1910–16), bulletins, and circulars; chief among the last are those dealing with the honeybee and the large larch sawfly. Very recently he completed an important work on the conservation of the wild life of Canada, the manuscript for which is now ready for the press. The publication in 1919 of the various parts of an important volume on the insects collected by the Canadian Arctic Expedition, 1913–18, was brought about under his direction.

Dr. Hewitt's high reputation was by no means confined to Canada. In addition to a wide appreciation among scientific workers in England his rare abilities were soon recognized by entomologists in the United States, where economic entomology particularly has reached such high development. In the year 1913 he was honored by being elected a fellow of the Entomological Society of America. In 1915 he was elected president of the American Association of Economic Entomologists. He accepted the presidency of the Entomological Society of Ontario, Canada, in 1913, and in the same year was elected a fellow of the Royal Society of Canada. He was appointed honorary treasurer of the Royal Society in the following year, which office he held at the time of his death. He was a fellow of the Entomological Society of London, England, a corresponding member of the Zoological Society of London, and was an honorary fellow of the Royal Society for the Protection of Birds (London, England). The gold medal of the last-named society was presented to Dr. Hewitt on March 12, 1918, in grateful recognition of successful efforts to further the treaty between Canada and the United States for the protection of migratory birds. He was a recognized student of wild life preservation and rendered valued service in the capacity of secretary of the Advisory Board on Wild Life Protection. In March, 1918, he was elected president of the Ottawa Field Naturalists' Club for the year 1918–19.

A short time before his death he was chosen as the first president of the recently organized Institute of Professional Civil Servants. In addition he was president of the Ottawa Boys' Home, and an ardent supporter of the Boy Scout movement and a councilor of the Ottawa Humane Society.

Dr. Hewitt was born near Macclesfield, England, on February 23, 1885. He received his early education at the King Edward VI Grammar School, Macclesfield; afterward he entered Manchester University and received the degree of B.Sc. in 1902, M.Sc. in 1903, and D.Sc. in 1909. In 1902 he was appointed by his alma mater assistant lecturer in zoölogy, and from 1904 to 1909 occupied the position of lecturer in economic entomology. In 1909 he received the appointment of Dominion Entomologist and left England for Canada. His title was changed to that of Dominion Entomologist and Consulting Zoölogist in 1916.

Dr. Hewitt had attended the meetings of the Commission of Conservation, at Montreal, on February 18–19, last, at which he presented an important paper on "Furbearing Animals, Their Economic Significance and Future." Soon after his return to Ottawa on the twentieth he was taken seriously ill with influenza; this developed into pleural pneumonia and he died on February 29.



The late Dr. Charles Gordon Hewitt, Dominion Entomologist and Consulting Zoölogist of the Commission of Conservation, Ottawa

The versatility of Dr. Hewitt's interests in science, literature, art, music, and social welfare, combined with his great personal charm, had endeared him to many friends. His remarkable ability and well-directed ambitions—together with the beauty of his character—enabled him to accomplish more in life's work and in life's friendships during the thirty-five years he lived than is compassed by many of us in a long lifetime.

John Burroughs in Moving Pictures

Extracts quoted from *Nature Notes*, of February, 1920, by courtesy of his publishers, Houghton Mifflin Co.

ONE bright autumn day in 1919 Mr. Burroughs dropped into the Nature Bureau office and invited its secretary to "go to the movies" with him. Such an odd suggestion from one who holds artificial amusements in light esteem! But it turned out we were bound for a private showing of a film made in Roxbury, New York, birthplace of Burroughs, with himself as screen hero. Fancy the amazement of young John Burroughs, back in about 1850, had any one told him as he plowed the red loam of those Catskill fields near the old homestead, that a famous photographer would come more than a half a century later, with a camera so wonderful as to be almost witch-work, to "take" him and his famous Catskill scenery for a permanent record.

The keynote of the Burroughs film is struck with his own words,—"The longer I live the more my mind dwells upon the beauty and the wonder of the world." In his own handwriting we see this happy introduction to the scenes that follow. The film shows Burroughs, ruddy with health and tanned with his out-of-doors living, in old, wide-brimmed straw hat and worn sweater . . . He peers into the R. F. D. box in front of Woodchuck Lodge, and beaming like a boy at a Christmas tree, he digs out bundles of papers and letters . . . He trudges off to the house with them, then comes out—too fine a day to stay indoors. Across the garden patch he comes, headed for his "barn door study" . . . His desk is only a board on a box, but Burroughs is at home with such rude accommodations. See him grab up his field glass,—quick!—we all but see the bird flash past. He looks on to hills and flowery meadows, with the wind rippling the leaves and grasses . . . Here come three youngsters, a barefoot boy and two smaller girls, trotting down the road. Burroughs spies them and waves. They break into a run and come up panting. Burroughs pats the littlest one . . .

"Want to go exploring?" we fancy he's saying, for the kiddies grin and prance. "Come on, then, the wild things don't mind my bringing callers."

Mother Bluebird's nest in the big apple tree is Sight 1. Not far beyond is a stump, baited with corn and an apple—see that saucy chipmunk winking his eyes at the callers. A frisk of his tail and he's off. A few steps farther Burroughs points to a big, flat stone and pulls it up . . . A second later, a close-up shows the scurrying ants disturbed when he "lays bare to the sun the streets and galleries of their orderly kingdom." . . . The sight-seeing group passes through a meadow thick with wild flowers, and Burroughs points to a stalk of wild sunflower. A close-up shows us what they are all peering at—a gorgeous bronzy butterfly lazily opening and shutting its wings, as it feeds on the sweets tucked away at the heart of the flower. Burroughs whips out his hand lens and shows them a common hawkweed. Under the glass it looks as showy as a prize chrysanthemum! And on its stem, what do we see but a solemn grasshopper, "clown of the insect world," Burroughs dubs him. He almost seems to know he is being watched, and wags his feelers at us ludicrously . . .

Well, these "sights" are hot in the sun, and the natural history class is glad to turn aside to the spring, where Mr. Burroughs lies flat down and shows the children how to get a drink nature's way . . . At the edge of the spring is a spotted wood frog . . .; and right under that bunch of ferns Burroughs picks up a newt,—it looks almost jewel-like against his bare palm. The film hurries along, and now we are watching a short lesson in geology. Burroughs points to the hills, and then shows the children glacier marks on the rocks along the road, scratches made ages ago when the glaciers were helping grind down those hills. And years and years ago, before John Burroughs had thought anything about geology, he put his boyish initials on the rock, and here they are . . . Now we see him bidding good-bye, and waving as the children scamper off. They don't know it, but the best lesson they have been learning is a scrap of Burroughs' philosophy:

" . . . The essential things in life are near at hand, and happiness is his who but opens his eyes to the beauty which lies before him."

Nature in New York's Lower East Side

An introduction to the work of the School Nature League of New York City

OF the hundreds of thousands of children living in crowded quarters in New York's Lower East Side, many have never seen a growing flower, and do not know that a frog, a lizard, and a shark look nothing at all like a caterpillar. But they have been taught how a flower springs up from a seed and a caterpillar becomes a chrysalis and then a butterfly, and they are all eagerness to see these phenomena. They cannot be taken to the woods, so the woods are being brought to them through the work of the School Nature League, an organization which came into existence three years ago as an outgrowth of Mrs. John I. Northrop's work with committees from the Associate Alumnæ of Hunter College and the Public Education Association.

The Board of Education of the city of New York has permitted space to be set aside for the exhibition of nature material in seven public schools, and every day the children come with their teachers at the scheduled hours for lessons. Then, to certain of the nature rooms, they are allowed to return to show their parents or their small brothers and sisters the unknown wonders. The material is necessarily limited and requests of the teachers of other schools for rooms have had to be refused, as the membership of the League is small and the heavy work of collecting, distributing, and caring for specimens is done by volunteers. But pupils from schools near by are brought to visit the established nature rooms, and twice a week material is distributed to any teachers who apply for it.

Each nature room has an aquarium set in the midst of a miniature sandy beach strewn with shells and starfishes. There are various mounted birds and small mammals (loaned by the American Museum) which are arranged in their habitats whenever these are possible of duplication in a simple way. Many birds' nests have been contributed. There are tables of garden flowers and wild flowers which, like the other exhibits, are made to vary with the seasons. Moss gardens with their small sprouting ferns, creeping vines, and shrubs in bud seem to give these city children an inexpressible happiness. Even stones and the bark of trees are objects to be examined with close attention and respect. One boy, of limited experience in country scenes, happily and with conviction summed up the whole impression by saying it was "just like a cemetery."

Perhaps the success in teaching appreciation of nature is most noticeable at the school for the deaf and dumb (Public School No. 47). Here, in the small space allotted on the platform of the assembly room, gather the eager, smiling boys and girls. To them this breath of the out of doors means more than to the ordinary child. Many of them manufacture, in paper, models of the flowers they see, and later they duplicate them in cloth and silk, for this school tries to give an equipment for earning a livelihood, and one of the many methods is through supplying the commercial flower houses of New York.

Three times a year special flower exhibitions are held in schools having no nature rooms and situated in neighborhoods remote from the schools which have them. Contributions are sent in from many people, and for three days some grade school play-room is transformed into a "florist's shop." Each "show" is visited by three or four thousand children who are gaining their first knowledge of plant life—not so much knowledge relatively, perhaps, as the desire for it, which is really the purpose of the exhibit. The children display an eager pride in learning names and being able to "match them up with the flowers," but their delight is no greater than that of their mothers, who are invited to attend in the afternoons and who are usually waiting for the trucks which bring the plants, hoping to be able to beg a flower to take home.

Even these occasional exhibits seem to make a lasting impression on the child mind, and the interest in reading lessons and the school stereopticon steadily increases. For nature study is not only visual instruction but inspiration as well when it is carried into the Lower East Side.—RUTH E. CROSBY, Assistant Curator in Public Education, American Museum.

Progress in Saving the Redwoods

Congressman Lea's resolution passes the House of Representatives

IT will be a matter for rejoicing to those who have followed the movement to save the redwood forests of America and have been heartily wishing success to the bill introduced at Washington in 1919, by Congressman Lea, of California, to know that the following resolution passed the House of Representatives on May 3 (an item which the delay in publication of NATURAL HISTORY allows us to present). This resolution will have an important bearing on the national aspect of the redwoods question:

Resolved, That the Secretary of the Interior be, and is hereby, directed to investigate and report to the House of Representatives as to the suitability, location, cost, if any, and advisability of securing a tract or tracts of land in the State of California containing a stand of typical redwood trees of the species *Sequoia sempervirens* with a view that such land be set apart and dedicated as a national park for the benefit and enjoyment of the people of the United States and for the purpose of preserving such trees from destruction and extinction, and also as to whether or not the whole or any part of such lands or the purchase price thereof would be donated to the United States, and the probable cost of maintaining such lands as a part of the national park system.

Change of Personnel in the Forest Service

The people of the United States give grateful commendation for achievement to Colonel Henry S. Graves, and cordial greetings to Colonel W. B. Greeley, who succeeds him as Chief Forester

VARIOUS difficulties attending work in science in government positions compared with that in private and commercial positions, added to the low remuneration in government service, is depleting the scientific staff at the United States Capitol. Among those who have resigned is Colonel Henry S. Graves, who has held the position of Chief Forester for ten years. The following paragraph, which states frankly an underlying cause of his resignation, is quoted[1] from his letter to the Secretary of Agriculture:

Since the pecuniary returns afforded professional and scientific men in the government service inadequately provide against exhaustion of the working powers which must inevitably take place in time, and entail sacrifices from which employment elsewhere is free, the only course consistent alike with self-respect and a regard for the public interests seems to me to be retirement from office before efficiency has been impaired. Present conditions, which amount to a heavy reduction in the rate of compensation in practically every branch of the government service, emphasize this point of view.

Secretary Meredith accepted the retirement in a letter of appreciation from which extracts are here given:

My dear Colonel Graves:

Your decision that you cannot, in justice to yourself, continue longer at the head of the Forest Service is one which I have received with the deepest regret. I am compelled to accept it much against my inclination, because I cannot, in fairness to you, do otherwise. The loss of your services, however, is a matter of great moment to the Department of Agriculture, as well as to the public interests which you have so effectively protected and advanced . . .

The decade through which you have guided the Forest Service has been notable in accomplishment . . . More and more you have made the National Forests serve the public welfare . . . You have seen to it that they are utilized in helping the home builder, in promoting local prosperity, and in contributing largely to the benefit of the people as a whole. Thus you have given stability and permanence to the public forest enterprise—which means true development as against destructive exploitation.

You have put the handling of the public forests on a thoroughly business-like basis from every standpoint. Under severe handicaps and discouragements of a kind unknown in private business, you have secured an admirably trained personnel, developed a system of administration which I believe to be unsurpassed in effectiveness in any branch of the Government . . . At the same time, you have recognized that the work must be based on technical knowledge—that the public welfare must be served by

[1] Through courtesy of AMERICAN FORESTRY.

experts and specialists, just as private business is . . . You have, therefore, emphasized the importance of scientific research and of the application of its results in the business of administration.

You have also carried to substantial completion a great work of land classification . . . so that large areas, in the aggregate, of agricultural lands have been opened to acquisition and conversion into farms, while the lands suited to permanent public ownership and administration for forest purposes have been classified as such . . .

On your initiative primarily a policy of road building for the development of the National Forests and the benefit of the public has been entered upon. During the war you not only brought your organization through intact and enabled the National Forests to contribute up to capacity to the war effort of the country, but you employed it extensively in the location of forest supplies of war materials and in the solution of important research problems relating to wartime uses of forest products . . . Within the last few months you have taken the lead in a movement which I believe to be of the utmost importance, for extending the practice of forestry to lands now privately owned . . .

These are large services. By wise judgment, energy, vision, and untiring devotion you have rendered them to a degree that has been and is the pride of all your friends. They entitle you to a large measure of gratitude from the public, to whom they have been rendered, and you may justly be proud of the record you have made . . .

(Signed) E. T. Meredith
Secretary of Agriculture

Colonel Henry S. Graves, Chief Forester of the United States, retiring May 1, 1920, after a decade of government service. He has used his influence that the forests, while remaining forests, should be utilized in promoting local prosperity and the good of the people as a whole

The successor appointed is Colonel W. B. Greeley, assistant forester in the government service in charge of the departments of silviculture and research. To him the scientific men of the country give greeting and offer cordial coöperation, where that is possible and desired, in the high work of his office. Colonel Greeley was educated at the University of California and at Yale Forest School, and entered the United States Forest Service in 1904. He had charge of the American Expeditionary forestry forces in France during the war after Colonel Graves had spent two months in France in preliminary inspection of conditions and formation of plans for equipment and organization. This work put Colonel Greeley in charge of 21,000 forestry troops and 95 sawmills. In his work in field forestry in America he showed notable executive ability in the years when he was district forester in charge of the national forests of Montana and northern Idaho—a total area of 29,000,000 acres.

Colonel W. B. Greeley, successor to Colonel Graves, was in charge of the American Expeditionary forestry forces during the World War

What the Blind Are Doing

By WALTER G. HOLMES

President and Manager of the *Matilda Ziegler Magazine for the Blind*

THE scarcity and high price of labor seem to have given the blind their opportunity to show what they can do to fill this need, and right well they seem to be doing it. From every section come reports of blind workers, both men and women, who are doing successfully various lines of work in factories right along with the sighted worker.

The blind do especially well the assembling of small parts of all kinds of machinery, and if the managers of all big plants would only do so, they could give work to many blind that would prove lucrative both to the employer and the worker. Dr. Schuyler B. Wheeler, of the Crocker-Wheeler Co., has twenty-five or more blind employed in that big armature works. In Chicago, a number are doing all the reed work in a factory making gocarts; one of these men, totally blind, is earning forty dollars a week and another more than thirty dollars.

A candy factory in New York employs fifteen blind girls who pack and wrap the candy. It is interesting to see the speed with which they move their white-gloved hands when at work. Many, of course, do not attain the speed of the sighted workers but the blind worker is not turned from his work so much by abstractions seen by the sighted worker, and hence at the end of the day often has done as much as the one with good eyes. A number of blind are finding work as dictaphone operators, many acquiring the speed and accuracy of the sighted typist.

And what are the blinded soldiers doing? From Evergreen, the Red Cross Institute for the Blind at Baltimore, they are being turned out into various lines of work—life insurance, real estate, massage, and several are in charge of stores,—two are running their own grocery stores, two their musical instrument stores, and others are preparing to engage in similar work in their home towns.

The embossing of books in revised Braille, the new uniform type for the blind in this country, is receiving an impetus, and many leading authors are supplying the money for embossing the plates of their latest stories. "The Daughters of Ohio in New York" raised the money for one book which has just been published. It costs from \$300 to \$500 to emboss the plates in brass for an ordinary-sized book. Any one who wants a lasting monument, "as lasting as brass," could give pleasure to thousands of blind if he would supply the plates for some additional book, for the blind have so little literature and do so crave to read what the sighted world is reading. When these plates are made they last for all time, and editions can be printed from them as needed; the libraries pay for the printing and binding, and the Government sends them free of postage to and from the blind reader in his home.

Courtesy of Outlook for the Blind

Blind men at work in a Chicago factory, giving wholly satisfactory results and earning from \$15 to \$40 a week

A State Should Protect Its Antiquities

THERE has been given all too little attention in the United States to the protection of aboriginal documents. Especially is this true in the West and Southwest, although some years ago New Mexico and North Dakota followed the early example of Ohio, and passed protective laws. Ohio not only passed protective legislation many years ago, but also adopted the policy of establishing state parks about some of its most famous earthworks. Two remarkable ruins, Fort Ancient and Great Serpent Mound, were preserved in this way. In very recent years state legislation covering antiquities has been enacted in two additional states, Alabama and Arkansas.

Dr. Thomas M. Owen, director of the department of archives and history of the state of Alabama, now calls attention to an act of the state legislature of 1915. This law makes archæological exploration within the state *without formal permission from the state government* an offense punishable by heavy fine. The restriction certainly seems adapted to the prevention of loss to civilization of valuable historical data, and is worth study by states not possessing such legislation. It says, in part:

"That the State of Alabama reserves to itself the exclusive right and privilege of exploring, excavating or surveying, through its authorized officers, agents or employees, all aboriginal and other antiquities, mounds, earthworks, ancient or historic forts, and burial sites within the State of Alabama, subject to the rights of the owner of the land upon which such antiquities are situated, for agricultural, domestic or industrial purposes; and that the ownership of the State is hereby expressly declared in any and all objects whatever which may be found or located therein." [1]

Dr. Owen emphasizes, however, that for legitimate scientific investigation the law is not intended to be "exclusive or prohibitive," but merely to defend the state's aboriginal treasures against the unqualified—"those people who would desecrate and destroy them for commercial purposes," leaving no records for history.

The protective law in Alabama was brought about through the activities of the Alabama Anthropological Society, which was the pioneer in such work in the South. For fifteen years this organization has been collecting implements showing the handiwork of aboriginal man in that section of America and depositing them for safe keeping in the department of archives and history. It has also recorded and mapped practically all of the ancient town sites within the state's boundaries.

[1] From Alabama General Laws (1915), pp. 729-30.

Indian Music

THAT Indian music is apt to produce in our minds a sense of the grotesque is probably due in large part to its lack of implied harmonies. For an instant we may feel that simple harmony is implied, but in the next this is contradicted.

When Indian music is sung by a number of people, they all sing the air. Sometimes the octave is introduced, but there is no harmony such as our contralto, tenor, and bass parts. Our harmony creates nothing but confusion in the minds of primitive peoples, and our singing they consider barbarous.

When for the first time we hear a piece of Indian music reproduced by the phonograph, the inclination to laugh is very likely almost irresistible. It usually strikes us as being a ridiculous performance intended to make us laugh. It is certainly different from anything we have ever heard, and we may like it in a way, and be ready to hear it repeated; but the idea that it is music probably does not occur to us.

The fact is that primitive Indian music is not our music, and cannot be written out correctly in the modern form of notation. The best that can be done with many of the tones is to place them on the line or space of the staff representing the note they approach nearest in pitch. Suppose the note we are taking from the Indians' voices or phonographic record is sharper than E yet nearer to it than to F, there is no other way than to write it E, and so on with the other tones. It is easy to see that a song so written will not be satisfactory when played on the piano. The factor that adds most to the strangeness of much primitive music is the difference in musical scales. As everybody knows, we divide the octave into twelve tones which form the diatonic scale, or as it is often called, the piano scale. Now most primitive peoples use the pentatonic or five-tone scale. This difference in the division of the octave makes primitive music sound all out of tune.

The pentatonic scale is so widespread among primitive peoples that it must be considered the natural one in the earlier stages of musical development. It was in use in China, in 300 B.C., and probably much earlier. "The fact that most of the Chinese native airs are founded on the pentatonic scale accounts for the difficulty the grown up Chinese have in singing our Western tunes that have semitones. While they sing perfectly such tunes as 'Auld Lang Syne,' . . . 'Ye Banks and Braes,' . . . 'Happy Land' and 'Jesus Loves Me,' which . . . contain no semitones, they cannot possibly sing correctly 'Old Hundred,' which seems so simple to our ears, because it has a semitone in each line."[1] If the singer of primitive songs finds our diatonic scale difficult or impossible and considers our music barbarous, is it any wonder that music in his five-tone scale sounds badly out of tune to us?

It seems to be a popular belief that the world is losing a vast amount of good music through the neglect of modern composers to use Indian tunes, or parts of them, as motives in their symphonies and other compositions. It is probable, however, that the world is no poorer for this neglect for, as has been stated, primitive music that has not been influenced by contact with the white man is not music, at least not good music, to our ears.

I grant that it might furnish the inspiration for music, just as a handful of differently colored shell beads, or a thousand and one primitive objects in the American Museum are now furnishing artists with inspiration for beautiful designs for the decoration of silks and other textiles. I will go so far as to say that a piece of Indian music in which the singing and drumming are in two different rhythms might furnish the composer with an inspiration; like the design artist, however, he must not copy, but produce something that shall remotely, if at all, resemble the thing that inspired it.

It may be said that a number of valiant attempts have been made by enthusiastic American musicians to use Indian folk songs as material for artistic music that should be purely American. The material has invariably proved refractory even in the hands of skillful composers. It has always turned out that the process of artistic elaboration robs the songs of their original quality.

Although Indian music, as music, has no very great value to us, it can certainly furnish very important data for the ethnologist. "It seems that music offers one of the very best trait-complexes for the study of diffusion and invention. It is one of the weak points in the careful, painstaking study of ritualism now prosecuted by American anthropologists, for when a ritual passes from one tribe to another (of which phenomenon we have already many instances) we may expect that its music will be carried more faithfully than anything else."[2]

It is a very common mistake to suppose that Indian music is largely in a minor key. Travelers and novelists almost invariably tell us of primitive peoples "singing a sad song in the minor key." I once asked one of these travelers why he had said the music he had heard was in minor. His answer showed that he thought all primitive music in a minor key. As a matter of fact it seems that at least 65 per cent of recorded Indian music is in a major key. In many songs the tones are in such melodic sequence that it cannot definitely be said they belong to either key.

Music plays a very important part in Indian life. It is incorporated in the rituals, every ceremony has its particular songs; certain ones are for the warrior, others to be sung in times of danger or necessity; the medicine man has his songs used while healing the sick; the lover his which he sings to the girl of his choice. In fact every phase of Indian life is expressed in music.

The enjoyment of music depends principally on beauty of form, emotion, and association. The Indian thinks his music beautiful, and as it is so intimately connected with his traditions and everyday life there is no lack of association.

[1] From a paper by Mrs. Timothy Richard on "Chinese Music," read before the China Branch of the Royal Asiatic Society in 1898.

[2] Quoted from *The American Indian*, by Clark Wissler, pp. 147–148.

Indian music heard in the wilds, in connection with the ceremonies of which it forms a part, is appropriate and all that could be desired, but when removed from its natural setting and judged by modern musical standards it is found wanting.—CHARLES W. MEAD, Assistant Curator of Anthropology, American Museum.

Galleries for Fine Arts and Industrial Arts

THE large number of persons interested in the crafts and the graphic and industrial arts will rejoice to know that these arts have in prospect an adequate building for work and display in New York City. A campaign to raise $250,000 for such purpose was inaugurated recently by Mr. Cass Gilbert, president of the National Institute of Arts and Letters, and other prominent artists, at a dinner at the Hotel Pennsylvania, and met at once with cordial response. The following letter from the president of the National Academy Association removes any confusion there may have existed in the minds of our readers concerning the aims of the various "Fine Arts" organizations on the one hand and societies of the "Industrial Arts" on the other.

To the Editor of NATURAL HISTORY:

Replying to your inquiry regarding the relation of the scheme for the coöperative art building which was launched recently at the Hotel Pennsylvania, New York City, to the plans of the National Academy Association which has for its purpose the erection of a Fine Arts Building for the city of New York, I would say that they do not in the least conflict with each other. There are scores of concerns—societies, institutes, and associations, which are doing excellent work in this city along the lines of applied art. Many of these like the National Society of Craftsmen, Society of Jewelry Designers, and Pictorial Photographers of America, are industrial organizations. Personally all art appeals to me as existing on one and the same plane, but the distinction has been made between the "Fine Arts" and the "Industrial Arts."

These Industrial Art Societies are in immediate need of working quarters. They want a clearing house, employment bureau, sales galleries, and offices. They aim to discover talent and direct it into the channels for which it is most fitted. They have long worked on these lines in hired quarters scattered through the city. It is time that they should have a building of their own, which they can occupy continuously. Six societies have coöperated in this movement with good prospects of success.

A Fine Arts Building, such as the Academy hopes for, would be primarily for the exhibition of painting, sculpture, architectural designs, and engravings. It would also afford opportunities for the exhibition of the products of applied art—for the Academy stands for the encouragement of arts in general. It would also furnish permanent quarters for certain organizations, mostly the larger exhibiting societies now in the membership of the association. But it could not possibly house and give working space to all the societies engaged in the many branches of applied art.

If the Fine Arts Building eventuates, the Academy Association will look to these industrial art bodies for exhibits in their special lines. These lines are parallel to, and do not conflict with, those of the Academy, which gladly welcomes the new union of these industrial art societies and wishes them success.

(Signed) HOWARD RUSSELL BUTLER
President, National Academy Association

"Nature and Science on the Pacific Coast"[1]

A book so charming, authoritative, and valuable for the region it covers that it is an example for similar local volumes in other parts of America

THIS handbook may well be taken as a model for others, not only because of the importance of its information and the interesting way in which it is imparted, but because of its attractive make-up and convenient size.

Prepared under the auspices of the Pacific Coast Committee of the American Associa-

[1] *Nature and Science on the Pacific Coast.* A guide book for scientific travelers in the West. Edited under the auspices of the Pacific Coast Committee of the American Association for the Advancement of Science. Illustrated with nineteen text figures, twenty-nine half-tone plates, and fourteen maps. Paul Elder and Company, San Francisco.

tion for the Advancement of Science, for use by the members of that Association and for scientific travelers at the time of the Panama-Pacific Exposition, it may be recommended to all who desire accurate information regarding the most important and most interesting features of that region. The articles are by men who are authorities on the topics of which they treat, and starting with "The Approaches to the Pacific Coast" by Dr. Frederick J. Teggart, they end with a chapter by Dr. A. O. Leuschner on "Scenic Excursions." In between are chapters on the Spanish settlements, the Panama Canal, weather conditions, vertebrate fauna, forests, observatories, and museums. Dr. J. C. Branner writes of earthquakes, Dr. Jordan of the fishes, Dr. Kofoid of ocean life in general, while literary landmarks are discussed by Professor Seward, and legal and political development by Professor McMurray. The beasts and fishes as well as the insects and the teeming invertebrate life of the sea are all described, and Dr. J. C. Merriam gives us a glimpse of the life of past geologic ages.

Professor Vernon L. Kellogg, who writes of the insects, also contributes a brief account of Luther Burbank and his work, in which he tells of some of the things which Burbank has really done and of some he has not.

The articles themselves, or many of them at least, are literature, but really the book must be read to be appreciated, and this brief review is merely to call the attention of prospective tourists to the fact that they should prepare for a visit to the Pacific Coast by reading this book. It will surprise many to learn that the project of the Panama Canal was seriously considered as early as 1530, and one can but admire the courage of those early engineers whose sole reliance was upon picks, shovels, and man power. It will also be a surprise to learn that the oft mentioned Kuroshiwo Current plays no part in creating the mild temperature of the Pacific Coast region, but that this is really due to the westerly winds.—F. A. Lucas, Director, American Museum of Natural History.

Notes

Dr. William H. Maxwell, superintendent emeritus of New York City's public schools, died on May 3, at the age of sixty-eight. Dr. Maxwell had served the city as superintendent for thirty-five years when the emeritus position was especially created for him.

The following letter by his successor, Mr. William L. Ettinger, was brought formally to the attention of the Board of Education and was later read in all the schools throughout the city:

"His was the master mind in the reorganization of the school system, made possible by the enactment of the charter; in the establishment of the merit system as a substitute for advancement by political preferment; in the development of our high school system, and in the protracted but successful struggle to enrich the elementary curriculum in order that our children, rich and poor, might enjoy the benefits of a liberal education. His was the task and the privilege to interpret the best educational thought of the time and through his energy and leadership to embody such ideals in the daily work of our school system. Dr. Maxwell's death is an irreparable loss not only to our city, but to education throughout the nation."

The United States Supreme Court has dismissed the injunction proceedings brought by the state of Missouri to restrain the United States game warden from enforcing in that state the treaty between the United States and Great Britain for the protection of migratory birds and the act which carried out the provisions of this treaty. The plaintiff maintained that the statute unduly interfered with the rights of the state, reserved under the Tenth Amendment, and interfered with the sovereignty of the state and the property rights of its citizens. The court held that inasmuch as the birds were only transitorily within the state and could be protected only by international action, the treaty and act were within the sphere of federal enactment. "Here national interest of very nearly the first magnitude is involved," said Justice Holmes in rendering the majority opinion. "It is not sufficient to rely upon the states." . . . "We see nothing in the Constitution that compels the Government to sit by while a food supply is cut off and the protectors of our forests and our crops are destroyed."

Courtesy of Zoölogical Society Bulletin

The Battery, New York, in 1824, showing "Castle Garden," our present New York Aquarium building. Reproduced from an old drawing by Imbert, which represents the landing of General Lafayette at Castle Garden in August of 1824. The tower at the extreme right is referred to in the writings of Washington Irving as "the churn." It appears in only the very old views of the Battery

The March number of the *Zoölogical Society Bulletin* is devoted to an account of the interesting history of the New York Aquarium building, and reproduces a large number of quaint and valuable old paintings and prints. The building in Battery Park is one of the oldest surviving structures in New York City. It was constructed between 1807 and 1811 for a fort and served in this capacity until 1823, being known first as the Southwest Battery and later as Fort Clinton. After the fort was dismantled the city turned the building into an amphitheater called Castle Garden, and as such it served for many notable historic occasions. Lafayette, Kossuth, and the Prince of Wales were received here; Jenny Lind here made her American début; and from its platform Professor Morse demonstrated his discovery of the telegraph. In 1855 the place was made an emigrant station, but still carried its old name until the Aquarium took it over in 1896. When first built the fort stood a hundred yards from the shore, for the present sea wall was only finished about 1870. The earliest and one of the best pictures of it is preserved in the design of an eighteen-inch blue platter dated 1815. The story is fascinating history. But the public need today calls emphatically for a large modern structure comparable in beauty of architecture and in equipment with the great aquarium at Naples and the new building under construction in San Francisco. The citizens of New York City are proud of the history of the old Fort Clinton and Castle Garden down at Battery Park, but are not proud of the building which houses their Aquarium today.

It is reported by Dr. Stephen T. Mather, director of national parks, that for the two years preceding 1919 about fifty-five thousand cars of private automobilists traveled the parks annually, while in 1919 there were more than one hundred thousand. The total number of visitors to all the national parks by all methods of travel exceeded three quarters of a million. Yosemite, especially, gave pleasure to multitudes during the summer of 1919, and an unusually large number sought the higher altitudes. The hotel problem here has finally been solved by the Yosemite National Park Company, representing the business interests of Los Angeles and San Francisco. Improvements at an aggregate expenditure of $1,500,000 are being installed which will invite both winter and summer travel to this great scenic playground of America. One imperative need, not only in Yosemite but also in various other national parks, is that remote sections be made accessible by new trails and public camps.

The man who tours the West in 1920 and wishes to visit the United States national parks is to be congratulated that there is comprehensive and up-to-date information at hand. *The Book of the National Parks*[1] is recommended not only for its photographs, its accurate accounts and maps, but especially for the enthusiasm and joy in it. All Californians, however, and most American men of science, will take exception to the author's lack of appreciation of the value of John Muir's Sierra investigations.

As announced in *Science*, the second series of the Le Conte Memorial lectures will be given in the Yosemite National Park during the months of June and July, 1920. These lectures were instituted in honor of the naturalist and geologist, Joseph Le Conte, who for thirty years was a member of the faculty of the University of California. This year the speakers and subjects will be as follows: Dr. John C. Merriam, "The philosophy of Joseph Le Conte"; Dr. A. C. Lawson, "The geological history of the Sierra Nevada"; Dr. Joseph Grinnell, "The vertebrate animals of the Yosemite"; Dr. C. Hart Merriam, "Indian tribes formerly in Yosemite."

Mountain-lovers who search out the scenes that John Muir loved may now scale Half Dome, of Yosemite Valley, with comfort and safety. The Sierra Club, through the generosity of Mr. M. H. McAllister, has completed a zigzag trail and stone stairway which covers the first six hundred feet of the slope, and erected a double handrail of steel cables over the last eight hundred feet. Safety belts, fastened to the cables, are provided for those who desire them or have neglected to bring rubber-soled shoes, for this second section of the trail is composed of smooth, polished granite.

If the higher Sierra Nevada, accessible only to the traveler on horse back, are to be utilized for a public playground, it is necessary that the very limited grass supply be protected from cattle. Grass for fodder is found on only a few scattered meadows in the Sierra and in very limited amount. Even with a pack mule the traveler cannot carry sufficient supplies for a long trip, but must rely on finding enough grass for his horse. Cattle are grazing now on public lands up the very slope of Mt. Whitney.

The Twentieth International Congress of Americanists which was to meet at Rio de Janeiro in June of this year has been indefinitely postponed because of the unsettled state of Europe which will prevent many Continental anthropologists from attending. The next Congress will probably be held in 1922.

Mr. Louis R. Sullivan, assistant curator of anthropology at the American Museum, left on April 27 for the Hawaiian Islands where he will make an investigation of the origin and migration of the Polynesian race. His work will be done in connection with the Bishop Museum of Honolulu, and will mean a year's study of the skeleton collections and living representatives of the native Hawaiian population. Mr. Sullivan will bring back photographs and plaster casts for a new exhibit in the South Sea hall of the American Museum.

The investigation of the rapidly vanishing Polynesian race of the Pacific is provided for by a gift to Yale University of $40,000 from Mr. Bayard Dominick, of New York City. This fund will be disbursed through the Bishop Museum of Honolulu, and the expedition will be in charge of Professor Herbert E. Gregory, of Yale. Present plans call for a two-years' study by parties composed of an ethnologist, an archæologist, a botanist, interpreters, and assistants.

Professor Wilhelm Pfeffer, one of the pioneers in plant physiology, died in Leipzig on January 31. He was called in 1887 to the University at Leipzig, where later many European and American botanists resorted to his laboratory and lectures. His *Handbook of Plant Physiology* has been the standard reference work in that subject for two generations.

Dr. William T. Sedgwick, professor of biology at the Massachusetts Institute of Technology, has been appointed the first exchange professor from the Institute to the universities of Leeds and Cambridge, England.

At the meeting held in Rome on March 29, 1920, Professor Henry Fairfield Osborn was elected an Honorary Member of the Societa Romana di Antropologia.

Mr. Gifford Pinchot, formerly chief forester of the United States, has been ap-

[1] *The Book of the National Parks.* By Robert Sterling Yard. Charles Scribner's Sons, New York, 1919. Maps and illustrations, pp. 420.

pointed commissioner of forests of the state of Pennsylvania.

The Honorable Eugene A. Philbin, Justice of the Supreme Court of New York County, who died in March of this year, will be especially remembered in the metropolis as a founder and the first president of the Parks and Playgrounds Association through which he has materially assisted in the development of the city's parks and forestalled attempts at various forms of park exploitation that were constantly proposed.

During the summer of 1919 the death was announced of two of Germany's greatest scientists, Ernst Haeckel and Emil Fischer.

Ernst Haeckel, who died at the age of eighty-seven, was one of the most widely known zöologists of the last century both by reason of his special contributions to the science of zoölogy, and through his popular writings, some of which reached a phenomenal sale. Haeckel entered the study of zoölogy by the route, at that time not uncommon, of the medical profession, studying under the famous Virchow and Johannes Müller. After a very brief practice of medicine he attached himself as a zoölogist to the University of Jena, which has always been the most free of the German universities, and in spite of other offers remained there until his death. During the latter half of the nineteenth century when Darwinism was agitating not only zoölogical but also religious and philosophical circles, Haeckel came out as a champion of the new evolution, and his greatest technical works were contributions to this controversy. He was an admirable artist and illustrated with his own drawings not only his monographs, but his travels as well. Since the opening of the present century Haeckel turned his attention to the propaganda of a philosophy of monism which he championed as a new religion. He took an aggressive and bitter attitude on the question of the World War and in 1916 brought out a book on this subject under the title *Eternity*.

Emil Fischer, professor of chemistry in the University of Berlin and among the greatest organic chemists of all time, was but sixty-seven years of age at the time of his death. Fischer was trained principally by Adolf von Baeyer, whom he survived only a year, and after a varied academic career as assistant and *Privatdocent* he was called to the chair of chemistry in Erlangen and then in 1892 to Berlin. His most conspicuous investigations were in the syntheses of the sugars, the purines, and the proteins, researches which have had an immeasurable effect in other biological sciences. In 1902 Fischer was awarded the Nobel Prize in chemistry.

Peoples of the Philippines,[1] by Dr. A. L. Kroeber, professor of anthropology in the University of California, is the fourth of a series of handbooks, issued by the American Museum, which deal with primitive races and interpret the ethnological collections exhibited. The historical development of civilization is unusually well illustrated in the Philippines where the various cultural layers are readily traceable. Three varieties of man—exclusive of recent European and Chinese immigrants—are found on the islands and represent three cultural stages. These are the Negritos, an indigenous, primitive, dwarf Negroid race which still survives in the mountainous districts and on some of the smaller islands, but whose original culture and language have completely disappeared; the Indonesians, a rude oceanic people from southern Asia; and the Malaysians who brought over something of Hindu civilization. Today nearly nine-tenths of the Filipinos are westernized, but many of the old customs survive in the social fabric and there are still some remnants of the earlier cultures in remote corners. Professor Kroeber includes many text figures of human types and of artifacts, and six maps to elucidate racial distribution.

The American Forestry Association desires to register each memorial tree planted in the United States for the country's soldier dead, and will send a certificate to the person who reports to the association the planting of the memorial. The most unique project so far reported is that undertaken by the Women's Auxiliary of the Chamber of Commerce at Macon, Georgia. Memorial trees are to be planted on two roads which connect four towns, so that the trees form a cross with its center near Macon.

The school children of Jerusalem planted 500 trees on the Jewish Arbor Day in

[1] *Peoples of the Philippines.* By A. L. Kroeber. Handbook Series No. 8, American Museum of Natural History, New York. 1919.

furtherance of the plan of the Zionists to replace the forests destroyed through Turkish misrule and the necessities of the war. During the past year 369,000 trees have been planted in Palestine.

A MOVEMENT to reforest the denuded hills of China through the establishment of a national Arbor Day has been started by the College of Agriculture and Forestry at Nanking, according to a note in the *American Journal of Forestry*. Requests have been sent to all the schools in the country, native and foreign, urging the establishment of this holiday. Seeds will be supplied by the Forestry College.

AN important step has been taken toward the development of the many thousands of acres of forest land on Long Island, New York, through the establishment of two fire observation stations near Selden and at Flanders by the State Conservation Commission. The only trees at present growing over large areas on the island are oaks and pitch pine, although white pine and Norway spruce can be grown if given fire protection. The plan advocated by State Forester B. H. Paul in the *Conservationist* is for the development of municipal and county forests which, when properly protected, should give profitable returns in the form of posts, poles, and cord wood.

Courtesy of American Forestry

A "victory oak" on a school lawn, planted in memory of our American soldiers

ABOUT eight thousand boys and girls of Baltimore celebrated Arbor Day, April 9, by tree-planting ceremonies in the public parks. The trees will grow up with the children and always hold pleasant personal memories.

Two thirds of every tree cut is wasted, according to Dr. C. P. Winslow, director of the United States Products Laboratory, in an address before the Madison Section of the Society of American Foresters.[1] A large part of this waste is unnecessary, and it is the aim of the Forest Products Laboratory to bring about its elimination. One way in which the lumbering residue may be employed is in the manufacture of "built-up" wood, made by gluing small pieces together. Greater utilization can also be made of wood waste for chemical by-products and paper pulp, fields of work that are still open for further research.

THE significance of the practically contemporaneous evolution of the warm-blooded animals and the flowering plants is discussed by Dr. Edward W. Berry, professor of palæontology in Johns Hopkins University, in a recent number of the *American Journal of Science*. The flowering plants are characteristically fruit or seed bearers and aside from the development of these sources of food we cannot conceive of the appearance of birds and mammals in any numbers. The great differentiation and distribution of these animals in the comparatively short Cenozoic era is one of the most profound events in the animal evolutionary series. That this sudden efflorescence was closely associated with the appearance of the higher plants cannot be doubted. The small Triassic Prototherian predecessors of the mammals did not change greatly during a long lapse of time before the Cenozoic because of an unchanging food supply for which they had to compete with the dominant giant reptiles. The modification of

[1] *American Journal of Forestry*, Vol. XXVI, 1920, p. 254.

this food supply through the appearance of the flowering plants was perhaps one of the factors which not only favored the evolution of the higher mammals, but also "spelled the doom of the overgrown and specialized Reptilia of the Mesozoic."

Dr. W. H. R. Rivers, the eminent ethnologist of Cambridge University, England, was the guest of honor at a luncheon given by the Galton Society in March, while his colleague, Dr. G. Elliot Smith, of the University of London, was the guest of honor at another luncheon of the Society on May 5. Dr. Rivers and Dr. Smith are well known to American anthropologists, especially in connection with their contention that many of the burial customs and other cultural elements of ancient Egypt were carried far to the eastward by traders and in the search for gold and pearls, until they finally spread to distant localities in the South Seas and even to the eastern coasts of South America. Dr. Smith's researches in Egyptology grew out of his interest in the morphology of the cranium and brain of certain Egyptian mummies, which he studied while stationed at Cairo.

Dr. Joseph Grinnell, associate professor of zoölogy and director of the University of California Museum of Vertebrate Zoölogy, has presented his collection of skins of North American birds to the University of California. This gift contains 8312 specimens collected between 1893 and 1907.

Dr. John H. Finley has recently been chosen to head the Committee of Roosevelt Clubs in Schools and Colleges.

Dr. Nathaniel L. Britton, director of the New York Botanical Garden, has returned from a botanical expedition to Trinidad.

The State Conservation Commission of New York has furnished the post office at Albany with a stamp cancellation machine bearing the words, "Prevent Forest Fires. Protect Wild Life," and all mail passing through that post office is so cancelled. It is significant for the future beauty and wealth of the state that private landowners have been buying many thousands (at from \$2 to \$5 a thousand) of young Norway spruce, white, red, and Scotch pines, and Carolina poplar from the Commission for the reforesting of idle lands.

To encourage the artificial propagation of fur-bearing animals the New York Conservation Commission has waived the requirement of a bond of \$500 hitherto necessary. The Commission hopes that this will make it possible for people of small means to raise these animals, as there has been a great drain on the wild stock on account of high fur prices. The breeder's license of \$5 is still required except for the raising of foxes, which are not protected in New York.

It has been suggested that a possible solution, in small part at least, of the question as to where our common house fly (*Musca domestica*) spends the winter months is presented by the discovery of its larvæ in snails. Although extensive search has been made for the whereabouts during the winter of this most common pest, it has so far eluded detection. M. E. Séguy, of Rambouillet, France, is quoted in *Parasitology* as having discovered that the fly larvæ quickly destroy living snails, burrowing through the epiphragm and penetrating to the foot in the course of eight hours. In the middle of January M. Séguy collected fifty snails from a wall and placed them in jars at 25° C. Nine of the mollusks yielded numerous fly larvæ.

Professor Thomas L. Hankinson, of the Eastern Illinois State Normal School, has accepted the position of ichthyologist in the Roosevelt Wild Life Experiment Station at the New York State College of Forestry. Professor Hankinson has been engaged for seventeen years in the study of the fish of Michigan and Illinois and for five years has coöperated with Dr. C. C. Adams in the Oneida Lake and Palisades Interstate Park ecological surveys.

The scientific problems of the Pacific Ocean region will be outlined at a conference, to be held in Honolulu in August, of scientists and scientific institutions whose interests lie in and about the Pacific. The conference will be held under the auspices of the Pan-Pacific Union and the program will be arranged by the Committee on Pacific Exploration, of the National Research Council.

THE first really adequate geological map of Brazil is issued by Dr. John Casper Branner, President Emeritus of Leland Stanford Junior University, together with an outline of the geology of that country and extensive bibliographies.[1] This work, begun by Dr. Branner in 1874 and covering a considerable portion of his lifetime, stands a monument to his genius and industry. In addition to the author's own geological researches in Brazil, extending into all but two of the states, he has brought together not only all the published data but a large amount of information obtained from friends and acquaintances who had personal knowledge of various parts of the country. The map is on a scale 1:5,000,000, and thirteen subdivisions of the geologic column are represented. The outlines accompanying the map consist of an account of the stratigraphic geology of the country and of the general and economic geology by states.

LEAD poisoning in waterfowl as a result of swallowing shot which had accumulated from year to year in the mud about shooting stations has been investigated by Mr. Alexander Wetmore of the Department of Agriculture. Mr. Wetmore found by experiment on wild mallards at Bear River, Utah, that six pellets of No. 6 shot were always fatal and even as few as two might prove so. The symptoms of lead poisoning were partial paralysis, loss of flesh, and recurring spasms. An examination of the mud bottoms with an ordinary small sieve, within range of favorite blinds, revealed great quantities of shot which the ducks might easily swallow, as they have a tendency to take any small, hard object. What may be the effect on the actual mortality among wild fowl, however, cannot be determined.

THE absolute protection of seals has been extended by the government of New Zealand for the coming three years over all territory under its jurisdiction, and the exploitation of Macquarie Island has been denied by the government of Tasmania to the company which so mercilessly destroyed the wild life there. This eleventh-hour protection may yet save the seals, sea lions, sea elephants, penguins, and various sea fowl of this Antarctic island. Macquarie Island is the largest of a small group off the southern coast of New Zealand and was formerly a good hunting ground. The Australasian-Antarctic Expedition (1911–14) made its headquarters here, and at present a permanent weather and relief station is maintained on the island. It is possible that the island may be converted into a wild life sanctuary and used for a biological and meteorological station.

THE State of California Fish and Game Commission has issued a *Bulletin* which describes the spawning habits of a California silverside (*Leuresthes*). From March to June these little fishes bury their eggs in the sand of the ocean beach close to the high-tide line. These eggs are buried when the tides are highest and therefore remain above the reach of the water for a period of two weeks, at the end of which time their development is completed and they hatch on being washed out of the sand again. It seems that the action of the waves near high-water mark with the turning tide alternately cuts away and then refills the sand, and the time and place at which the fishes bury their eggs are delicately adjusted to this phenomenon, so that the eggs are situated during their incubation period farther below the surface of the sand than the fish would naturally bury them, and two weeks later are washed out mechanically by the high tide, whereupon they immediately hatch. The very existence of the species is dependent on delicate adjustment to one slight natural phenomenon.

A NEW horse mackerel (*Thunnus allisoni*) has been described by Mr. Louis L. Mowbray, of the Miami Aquarium, Florida. Three specimens were taken, one of which is 5 feet, 9 inches in length and 143 pounds in weight. This fish is closely related to a Japanese species. Other relatives are the "albacore" and the "tuna" of the Pacific, the former being extensively used in California canneries. The "tunny" of the Mediterranean fisheries is the largest bony fish known, and attains a weight of fifteen hundred pounds.

The new aquarium at Miami has been erected through the interest and generosity

[1] "Outlines of the Geology of Brazil to Accompany the Geologic Map of Brazil," *Bull. Geol. Soc. America*. Vol. 30, pp. 189–338, Pls. 7 (colored map), 8–10. June 30, 1919.

of Mr. James A. Allison, of Indianapolis. It is equipped with forty-eight tanks and four pools and will be provided with a thirty-five-foot collecting power boat.

The activities of scientific men in connection with the late war have resulted in a large volume of post bellum discussion with regard to organization and coöperation in scientific research. There is, for instance, a controversy between the protagonists of coöperation as against those who maintain that all productive scientific work of importance must be carried on by individual initiative. Dr. C. L. Shear, pathologist of the United States Department of Agriculture, in an article in the *Scientific Monthly* aims to reconcile these opposing views. Dr. Shear illustrates the necessity for coöperation by problems in plant pathology requiring the technical knowledge of pathologists, mycologists, entomologists, pomologists, and experts in refrigeration and marketing. The wide expert knowledge involved in such problems could not have been encompassed by a single individual, nor could it have been effectively partitioned among a number of scientists working independently, but it required the closest coöperation and mutual understanding. On the other hand, special problems not requiring too great a field of knowledge can be more effectively attacked by the individual working alone. But "Darwins and Edisons are rare. The future advancement of science must depend chiefly on the combined efforts of the mass of faithful seekers of truth whose names may never appear near the top of the scroll of honor of the world's greatest scientists." Both forms of research are required and there is plenty of scope for each.

The all too numerous surgical contingencies of the world war have been the cause of many new departures and expansions among which are the successful experiments of Dr. Serge Voronoff in human grafting, described in a recent number of *La Revue*.[1] Four months after the war started Dr. Voronoff established a department of osseous grafting at the Russian Hospital in Bordeaux where he received a large number of patients suffering from lesions accompanied with loss of bone. It was determined that the transfer of bony tissue was most successful if made from the patient himself and for this purpose the fibula served well. This thin bone in the leg is vestigial in man and can be dispensed with. Grafts were sometimes cut from the tibia, especially for repairing the arm bones, or fragments of the fractured bone were employed. Use of bones from the recently dead was also found feasible up to eighteen hours after death. In the transplantation of bones of other animals to man Dr. Voronoff has had some success, but he has definitely shown that this method does not produce a true graft, the animal bone merely serving as a scaffold for the growth of new human tissue. Such operations cannot ordinarily be performed until several months after the original wound has healed, as the tissues must be entirely healthy. The work now in hand as a result of the war is a task which, according to Dr. Voronoff, will consume ten years of continuous effort.

The shortage of essential minerals in European industry has given prominence to the recently effected settlement of the political status of Spitsbergen with its mineral riches and future possibilities. Dr. R. N. Rudmose Brown, British Arctic and Antarctic explorer and medalist of the Royal Scottish Geographical Society, has lately published the first satisfactory account in English of this archipelago[2] which he has had opportunity to study personally. Dr. Brown gives an account of the physiography, geology, fauna, and flora, mineral wealth, and a detailed history ranging from the early whalers and trappers to the treaty of Brest-Litovsk between Germany and Soviet Russia in which these two governments agreed to the internationalization of this island. Twenty-two illustrations from photographs, mostly by Dr. W. S. Bruce, picture effectively the topography and life of Spitsbergen, while a map reproduced from the *Scottish Geographical Magazine* outlines approximately the principal mining claims of Britain, Norway, Sweden, and Russia.

The Mineralogical Society of America was organized by a group of mineralogists

[1] Cf. May Tevis, "Human Grafting." *Scientific American Monthly*, Vol. I, 1920, p. 307.

[2] *Spitsbergen*, By R. N. Rudmose Brown. Published by J. B. Lippincott Company, Philadelphia; Seeley, Service & Co., Ltd., London. 1920.

from all parts of the United States and Canada at a meeting held at Harvard University on December 30. The *American Mineralogist* is to be the official organ of the society and will be enlarged to include research papers and abstracts. The following officers were elected: president, Dr. E. H. Kraus, of the University of Michigan; vice president, Dr. T. L. Walker, of the University of Toronto; secretary, Mr. H. P. Whitlock, of the American Museum of Natural History; treasurer, Dr. A. B. Peck, of the Bureau of Standards, Washington; editor, Dr. E. T. Wherry, of the Bureau of Chemistry.

Dr. Alfred J. Moses, professor of mineralogy in Columbia University, died on February 27 in his sixty-first year. Professor Moses was author of the standard American text on *Mineralogy, Crystallography, and Blowpipe Analysis* and his work on *The Characters of Crystals* (1899) was the first American treatise on physical crystallography, a subject that has since become of commanding importance. He received his doctorate from Columbia University in 1882 and has been connected with the institution since that time.

Upon the request of Dr. Gustave Straubenmüller, associate superintendent of schools, the departments of public education and of public health in the American Museum have entered upon an active coöperation in the campaign conducted by the city department of education against malnutrition among school children. Twenty traveling exhibits of food hygiene have been prepared for circulation in the schools, each exhibit including sixteen food models, a set of blocks which show the composition of certain common foods, and eight illustrated charts. The food models, which represent ordinary portions of lamb stew, oatmeal, spinach, tomato soup, and so on, have been designed with great care so that they may be used to illustrate the cost and calorie value of each food, and may be combined to form the breakfast, dinner, and supper of an ideal low cost dietary. The blocks illustrate the chief values of each food in specific food constituents. The charts present original data in regard to food composition and food values worked out by Miss Mary Greig, of the department of public health. The school exhibit was first shown to the public on the occasion of a lecture by Dr. Straubenmüller on public school lunches given April 10 in connection with a special exhibit of charts and cartoons prepared by the school children of the city and displayed in Memorial Hall of the Museum.

Mr. Frank E. Watson, of the department of invertebrate zoölogy in the American Museum, has returned from a three-months' expedition to Jamaica, where he made a collection of from twelve to thirteen thousand invertebrates, chiefly insects. Several rare species of hawk moths were obtained—one of the objects of the trip.

Mr. Van Campen Heilner, an associate editor of *Field and Stream*, spent several weeks in March at the American Museum coöperating with the department of ichthyology in the preparation of a table of record weights of fishes.

On March 31 last, Mary Austin exhibited a collection of Indian paintings at a tea given by the publicity department of the American Museum. The pictures were made by school children of the Rio Grande pueblos who had had no instruction in painting, and their value lies solely, as Mrs. Austin said, in the fact that here we have a product of the American soil untouched by any outside influence. Although the color is put on flat and the figures are arranged diagrammatically, there is evidence of genuine artistic ability; the colors are harmonious, there is some success in suggesting motion and rhythm, and there is an idea of perspective. The lack of connecting lines and the delicate clearness of contour in many of them remind one of early Japanese art; some of the silhouettes are decidedly Egyptian in effect.

In the main the paintings depict the religious ideas of the Pueblo Indians. The application of color is symbolical, and the various dances represent the ceremonies for attracting magic powers for protection against the enemy. There is an interesting analogy between the old mystery plays of England and the present Indian drama as shown in these paintings.

The contents of the Field Museum of Natural History in Chicago have been moved to the new museum building in Grant Park.

The auditorium of the new building is the gift of Mr. James Simpson, and will accommodate one thousand people. The Field Museum ended its fiscal year (1919) with a margin of $24,130 over the $156,380 provided by the trustees.

THE Museum of New Mexico is fortunate to have as one of its chief exhibits the building in which its collections are housed. The Palace of the Governors is a monument surviving from the earliest days of the Spanish conquest. Its early history is obscure, but within historical times its walls have served the rulers of a wide territory, for three hundred years, under the flags of four nationalities. The Museum took over this historic residence and maintains there, in connection with a new building, which is constructed in the same general style of architecture, a collection and library relating to the archæology, history, and art of the Southwest. The exhibitions record the pre-Spanish culture of this Pueblo region, including not only artifacts recovered from excavated areas, but also models of pueblos, and illustrative mural paintings. A gallery is also maintained where contemporary artists of the Southwest may display their paintings before dispersing them among the art centers of the country.

NEW MEXICO is making an effort to preserve its original style of architecture, the Spanish idea of building expressed in adobe. The towns of Santa Fe and Taos, both well known centers for artists and tourists, are encouraging the old style because it is more beautiful, enduring, and economical. The new hotel and school at Taos are to be in adobe, like the museum at Santa Fe, and the United States Government will construct its New Mexico buildings of the same material.

THE fiftieth anniversary of the Wisconsin Academy of Sciences, Arts, and Letters was celebrated at a meeting of the Academy, at Madison, on April 23. Dr. Thomas Chrowder Chamberlin, professor emeritus of geology in the University of Chicago and one of the few living founders, addressed the session. Professor Chamberlin was recently the recipient of the Hayden Memorial Medal of the Academy of Natural Sciences of Philadelphia.

PROFESSOR A. S. PEARSE, of the University of Wisconsin, officially represented the American Museum of Natural History as Associate Member of that institution, at the Fiftieth Anniversary of the founding of the Wisconsin Academy of Sciences, Arts, and Letters, at Madison, Wisconsin, on April 23.

THE announcement for the summer of 1920 of the Biological Laboratory at Cold Spring Harbor, Long Island, maintained by the Brooklyn Institute of Arts and Sciences, contains the usual courses given at the Laboratory in zoölogy, botany, and eugenics by a scientific staff under the direction of Dr. Charles B. Davenport.

The Human Skeleton, an Interpretation,[1] by Herbert Eugene Walter, associate professor of biology in Brown University, is written in popular style to give the lay reader insight into the curious mechanism of the human bony framework, its workings, and its origin. By "the interpretative method" Professor Walter arranges the subject of osteology so as to give meaning to the various parts of the human form in the light of comparative anatomy, embryology, and palæontology, and portrays nature's "experiments with skeletons," the evolution of their various features, and their development in the individual.

THE Brooklyn Museum has added to its exhibits a group showing the under-sea life of the cave-worn cliffs in the Bay of La Jolla, California, as a companion to the group previously constructed which portrays the coral reefs of the Bahamas.

THE thieves who broke into the museum of the Ohio State Archæological and Historical Society at Columbus on the night of March 19 were apprehended the following day. They had taken a number of cut gem stones, jewels, rings, revolvers, and edged weapons; practically all of these articles were recovered.

THE new greenhouses recently opened at the New York Botanical Garden include a lecture room of about two thousand square feet. Lectures on botanical subjects may now be given in congenial surroundings and conveniently illustrated by the growing plants.

[1] *The Human Skeleton, an Interpretation.* By Herbert Eugene Walter. Macmillan Co., New York, 1918.

The educational possibilities of the moving picture are being investigated by a committee appointed by Mr. Ernest L. Crandall, director of lectures and supervisor of visual instruction for the Board of Education of New York City. Dr. G. Clyde Fisher, associate curator of the department of public education in the American Museum, has been chosen to represent the Museum which was one of the first institutions to employ lantern slides and moving pictures in its work with school children. The committee, composed of teachers from some of the public schools and a few producers and distributors of motion pictures, will study the available illustrative material and list the best for the use of teachers. From the work already done it is evident that the producers are interested in the movement and glad to coöperate with the Board of Education to furnish the sort of material needed.

A *Guide to Nature-Study and Garden Opportunities in the Greater City* is to be published by the nature study and garden organizations of New York under the editorship of Mr. Van Eyrie Kilpatrick. The cost will be borne by the School Garden Association.

The bequest of $100,000 to the general endowment fund of the American Museum of Natural History has been received from the estate of Mr. A. D. Juilliard.

Upon invitation of the American Asiatic Association Mr. Roy Chapman Andrews delivered two lectures at Carnegie Hall upon the American Museum's Asiatic expeditions. The first was a discussion of the expedition to Mongolia, which had just returned. At the second lecture there was an exhibit of the natural color photographs taken by Mrs. Yvette Borup Andrews during 1916–17 in Yunnan and Burma. The Asiatic Association is planning other lectures to be given in various cities of the United States, in accordance with the proposed coöperation between this organization and the American Museum of Natural History.

The department of anthropology of the American Museum of Natural History has received a gift of four thousand specimens of prehistoric Egyptian flint implements and hammerstones from Mr. August Heckscher. They consist of hand axes, saws, arrow points, spear points, and knives dating back to the Old and New Stone ages.

Neither the formation and behavior of volcanoes nor the evolution of the continents of the earth is a phenomenon which one would at first thought consider a subject for a moving picture. The Educational Films Corporation, however, has reduced these geological events to the dimensions of an American Museum laboratory, where the world could be rotated with a dynamo, and the volcano fumes represented with hydrochloric acid and ammonia gas.

The volcano pictures are designed to elucidate photographs of actual volcanoes. Many, if not most, of the earth's volcanoes are found along faults or cracks in the earth's surface. The subterranean inflow of volcanic material causes the uplift of a given area, and where this cracks away from the adjoining portions of the crust a vent may be provided for the uprush of lava, resulting in either a broad lava flow or a volcano of the explosive type. To illustrate this phenomenon a series of strata was arranged behind glass with sand and felt which faulted and folded most satisfactorily when lateral pressure was applied. Meanwhile the intrusion of the lava was indicated in black paint on the glass after the manner of the cartoons commonly drawn upon the moving picture screen.

The arrangement of a model volcanic eruption presented a somewhat more complicated project. From a small black plaster volcano a cloud of steam and gas arose and mushroomed out in true canopy form, while copious lava streams of phosphorus ran down the volcano's sides and illuminated them as at night. In an explosion of flash paper the top of the crater disappeared by the drop of an electrically released bucket of sand and left the rugged remnants of the mountain's cone. A detail view showed a little red-tiled house receiving the full force of the rain of pumice, dust, and volcanic débris, and finally succumbing to the onrushing "lava" torrent.

After this success in manipulating a volcano the reconstructors of earth sculpture turned to the formation of the world as a whole and the origin of continents. The earth is not, as is most generally thought, a spheroid or flattened sphere, but tends in a slight degree, as its crust shrinks, to take the form of a tetrahedron. If a body of water covering five-sevenths of the surface were held on such a figure by gravity and the whole rapidly rotated, it would take the form of an "earth-shaped" body with approximately the same distribution of land and water as at present; that is, three continental bodies broad at the north and pointed toward the south (the Americas, Eur-Africa, Asia plus Australia) and in addition the Antarctic continent at the bottom point or coign. The earth's rotation tends to bring it to a spheroidal form, as the sphere is the body with the smallest surface in proportion to its volume, whereas the shrinkage of the crust tends to bring the earth to the tetrahedral form or the figure having the greatest surface for its volume. This latter is the form which a balloon takes in collapsing. To illustrate these operations in the formations of the continents the moving picture artists constructed a globe of such a form that when a rubber coating was stretched over it, the high points of the land as it stood in Cambrian times (the earliest geological age for which a map of the land has been drawn) showed through as prominences. Rotating the globe they exhausted the air under this rubber film, causing the latter slowly to collapse and reveal the outlines of the present continents.

This series of geological moving pictures constitutes the beginning of a wide project in visual education undertaken by the Educational Films Corporation which aims to produce complete courses for school use, at the same time embodying material which can be released on the general circuit.

A BILL creating a State Roosevelt Memorial Commission has passed both branches of the legislature at Albany, and is now before the Governor. Plans for the erection of the east pavilion and the African hall of the American Museum as a state memorial to Theodore Roosevelt will be presented to this Commission.

SINCE the December issue of NATURAL HISTORY the following persons have been elected members of the Museum:

Associate Benefactor, MR. HENRY P. DAVISON.

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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

MAY–JUNE, 1920

VOLUME XX, NUMBER 3

NATURAL HISTORY

VOLUME XX

CONTENTS FOR MAY–JUNE

NUMBER 3

M. C. DICKERSON, *Editor*

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

Subscriptions should be addressed to the Secretary of the American Museum, 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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Detail of American Museum mural by Charles R. Knight (see page 241). Copyrighted photograph

EVOLUTION'S MOST MAJESTIC CREATION

The woolly mammoth, a contemporary of the Crô-Magnon man in Europe, was a representative of the last Ice age, with an ancestry leading back to a time many hundred thousand years prior to the origin of early man. Through disastrous effects of the Glacial period, and latterly through attacks by his great enemy, man, the elephant's line of evolution is now ended. In fact, it is estimated that the period of the Age of Mammals as a whole will likely have closed by the middle of this century—that is, in but a paltry thirty years from this year 1920, through immediate destruction by man. What of conservation? Where are our adequate national and state animal preserves?

NATURAL HISTORY

VOLUME XX — MAY–JUNE, 1920 — NUMBER 3

From restorations by J. H. McGregor

TRINIL APE-MAN (*Pithecanthropus erectus*, see page 231) — NEANDERTHAL MAN (*Homo neanderthalensis*, see page 234) — CRÔ-MAGNON MAN (*Homo sapiens*, see page 235)

That these three restorations of prehistoric man form a progressive series, from left to right, is evident not only by the general form and the appearance of relative intelligence appreciated by the most casual observer, but especially by definite anatomical characters such as increased prominence of the chin, reduction of the eyebrow ridges, reduction of the prominence of the lower face as a whole, increased size of skull and of brain capacity (brain capacities of the three races from left to right: 858–900cc.; 1408cc.; 1550–1880cc.)

The Hall of the Age of Man in the American Museum

By HENRY FAIRFIELD OSBORN

FOREWORD.—An important event in the American Museum of Natural History is the approaching completion of the hall of the Age of Man, a sequel to the halls of the Age of Mammals and of the Age of Reptiles. In about two years from the present time this hall will be arranged with all its murals and collections, as the first undertaking of its kind to show the ancestors of man in their environment. Many years of study have been given to the work of arrangement of the hall, which will present a complete picture of the successive stages in the evolution of man, as well as of the splendid types of animals that surrounded him in the infancy of his mental development in various parts of the world. Many experts in various lines have coöperated in this work under the author's direction. Exchanges with the chief museums of the world have been brought together, and fossil gifts of priceless value, the products of years of exploration from the sands of Egypt to the tundras of the Arctic. The purpose is to show the entire environment of man and his ancestors during the last 500,000 years.—THE AUTHOR.

THE beginning of the Age of Man, some 500,000 years ago, roughly estimated as the close of the Age of Mammals, marks in reality but the beginning of the close of the Age of Mammals. The extinction of the most superb mammals that the earth has ever produced, during the early stages of human evolution, progressed from natural causes due directly or indirectly to the Glacial epoch. With the introduction of firearms the destruction has proceeded with increasing rapidity, and today it is going on, by the use of guns and steel traps, at a more rapid rate than ever. By the middle of this century man will be alone amid the ruins of the mammalian world he has destroyed, the period of the Age of Mammals will have entirely closed, and the Age of Man will have reached a numerical climax, from which some statisticians believe it will probably recede, because we are approaching the point of the overpopulation of the earth in three of the five great continents.

The Ascent of Man

The cradle of the human race was, in our opinion, in Asia, in regions not yet explored by palæontologists. One reason that human and prehuman fossil remains are rare is that the ancestors of man lived partly among the trees and forests; this does not mean that they were arboreal; they lived chiefly on the ground. Even when living in a more open country the ancestors of man were alert to escape the floods and sandstorms which entombed animals like the horse of the open country and of the plains. Hence fossil remains of man as well as of his ancestors are extremely rare until the period of burial began. Only two races, the Heidelberg and the Piltdown, are certainly known from the river drifts and gravels before the period of burials.

The human remains known consist principally of portions of skulls, of jaws, and teeth of members of these races. Individuals are now represented by casts in the hall of the Age of Man. The museum series began in 1915 with the gift of the J. Leon Williams Collection, and has been enriched by additions from the museums of London, Paris, and recently of the Neanderthal man of Krapina, presented by Professor K. Gorjanović-Kramberger, also the skull of Talgai, of South Africa, presented by Dr. Stewart A. Smith.

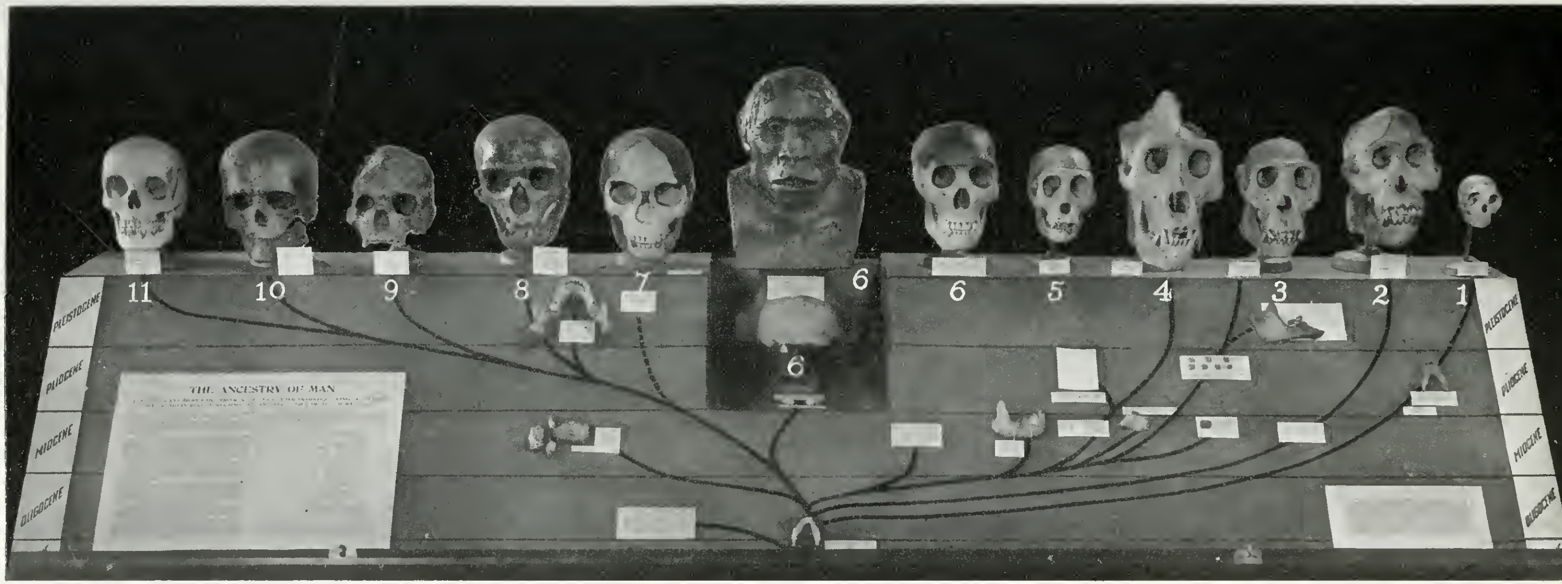
Man as a Primate

The ascent of man as one of the Primates was parallel with that of the families of apes. Man has a long line of ancestry of his own, perhaps two million or more years in length. He is not descended from any known form of ape either living or fossil. One hypothetical ancestral stage, of which we have a small jaw (see middle bottom of exhibit in Case 1, opposite page) found in the Oligocene of northern Egypt, is the *Propliopithecus*, which in the opinion of Professor W. K. Gregory, of the American Museum, our leading authority on the anthropoids, is at least structurally ancestral to the higher apes and man—in other words a possible prehuman link. From such an animal possibly four branches were given off leading respectively to the living orangs, the gibbons, the chimpanzees, the gorillas, and some of their fossil ancestors.

All these great man apes are distinguished from man by being more or less arboreal in habit; they are shown to be very far removed from the large-brained walking line which gave rise to our ancestors. Our own immediate ancestors did not live in trees; they were erect or semi-erect for a very long period, perhaps as far back as Miocene time. Back of this, perhaps a million years ago, was a prehuman, arboreal stage.

The Trinil ape-man, the *Pithecanthropus* of Java (see center of Case 1) is the first of the conundrums in human ancestry. Is the Trinil race prehuman or not? The restored head by Professor J. Howard McGregor, of Columbia University, is designed to show its half human, half anthropoid resemblance, as suggested by the top of the cranium, the only part known, which is far more human than that of any ape cranium, and at the same time far more apelike than that of any human cranium. It is not impossible that this ape-man is related to the Neanderthal man (skull shown in Case 3, page 234).

In this exhibit of the great man apes



MAN'S PLACE AMONG THE PRIMATES

Photograph of Case I in the hall of the Age of Man, the American Museum, showing the "Trinil race" of Java and other primates, living or extinct, which aid in reconstructing the ancestral tree of the human race

In the right half of this case are arranged the skulls of certain anthropoid apes—gibbon (1), orang (2), chimpanzee (3), adult gorilla (4), young gorilla (5), while on the left are models of skulls of the known races of man—Piltdown (7), Neanderthal (8), Talgai (9), Crô-Magnon (10), recent (11). Between these two groups have been placed a restoration of the skull and of the head of the "Trinil" or ape-man of Java (*Pithecanthropus erectus*) and a cast of the actually discovered brain case and two of the teeth (6, 6, 6).

The ascent of man has in general paralleled that of the families of anthropoid apes, as is shown by the "tree of descent" in black lines. Man is not descended from any known ape, either living or fossil, but a hypothetical ancestor of this entire anthropoid group, founded on a jaw discovered in Egypt (see cast at bottom center), is the *Propliopithecus haeckeli*. The case is ruled horizontally to indicate five periods (the most ancient, at the bottom, does not show in the photograph) of geological time (Eocene, Oligocene, Miocene, Pliocene, and Pleistocene), and below the recent apes are placed casts of the jaws or teeth of certain fossil apes, which have been discovered in deposits of these different geological periods.

On the human side of the case, immediately below No. 8, the Neanderthal skull, is shown a cast of the massive Heidelberg jaw (sown also in Case II, No. 7, page 233), representing a race which was perhaps the predecessor of Neanderthal man in Europe. Below this and on another branch are casts of teeth and fragments of jaw of a primitive fossil ape of India (*Sivapithecus indicus*), the patterns of whose molar teeth somewhat resemble those of man, but still more those of the orang. The card on the base line just left of the middle bears the drawing of the jaw with teeth of a fossil primate, *Parapithecus*, from Egypt, the most primitive of all known Old World monkeys and apes and considered to be the Oligocene survivor of an ancient type ancestral to the ancient *Propliopithecus haeckeli* (at the left in Case I) are placed for comparison some of the known extinct or fossil races of man, each ascending along a line of its own. Copies of the most recent discoveries in various parts of the world are placed in this series; in fact, this entire exhibit is designed to show from time to time our progress in discovery, to present actual evidence in place of theories and speculations, and to show how very limited this evidence is as compared with the abundant evidence in the ancestry, for example, of the horse (shown in the hall of the Age of Mammals).

The Most Ancient Human Races, Heidelberg and Piltdown

Unquestionably the most ancient human relic which has thus far been discovered is the jaw (see reproduction in Case II, left) of the so-called Heidelberg man, a fossil which may be 250,000 years old. From it has been modeled by McGregor the Heidelberg skull, which is very similar to the Neanderthal skull. The Heidelberg man may be ancestral to the Neanderthal man (shown in Case III, page 234).

A few deep brown fragments of a skull and jaw and one tooth (see casts in Case II, at the right) represent all the remains known of the Piltdown man, discovered in England a few years ago. Two reconstructions of the Piltdown skull have been made: the original by Professor A. Smith Woodward in London, in the British Museum, the second in this country by McGregor. The problem whether the Piltdown jaw belongs to this human skull or whether it belongs to a fossil chimpanzee is still not actually settled. The skull itself is of a rather fine type, with a flat forehead like that of the existing Bushmen of South Africa.

The Neanderthal Race, the Missing Link

The Neanderthal man represents the oldest fossil human race of which the skeleton is fully known. The remains are relatively abundant, and the American Museum owns reproductions of many skulls and parts of skulls found during the last half century in Spain, Germany, France, and Hungary. Foremost of these is the skullcap found near Düsseldorf, Germany, in 1856, which constitutes the type of the Neanderthal race itself.

Of great interest is the reconstruction by McGregor of a Neanderthal female head, based upon a skull found at Gibraltar in 1848, which gives us the head characters of the women of this very primitive race. All the remains discovered of the Neanderthal men are represented by reproductions in the American Museum excepting one, that of La Quina, France, which has just been presented by the United States National Museum.

Foremost in perfection is the skull from La Chapelle-aux-Saints, originally restored by Professor Marcellin Boule and reconstructed by McGregor. The latter distinguished American expert in the anatomy of palæolithic man is now engaged upon the reconstruction of the entire skeleton and body of the Neanderthal man. We may predict that this life-size Neanderthal model will be one of the most interesting exhibits in the American Museum when the work is finally completed after the many years of laborious study and research put upon it.

The Neanderthal Flint Workers (Mural I)

The mural of the Neanderthal group of flint workers shows in the distance, along the Dordogne River, herds of woolly rhinoceroses and woolly mammoths. The center of interest is the flint industry, which, with the chase, occupied the entire energy of the Neanderthals. This group awaits the completion of the Neanderthal body restoration by McGregor. Since the Neanderthal type is totally different

THE MOST ANCIENT HUMAN RACES

Photograph of Case II in the hall of the Age of Man, the American Museum, showing the Heidelberg and the Piltdown man of the early part of the Old Stone age in Europe, from before 100,000 B.C. to about 45,000 B.C.

The most ancient fossil relic of man is the massive jaw (7, just left of center) which was found near Heidelberg in deposits of the second Interglacial stage, perhaps as early as 200,000 B.C. A skull (8) has been modeled to fit this jaw by Professor McGregor. Of this skull the upper dental arch, the region of the cheeks, and the jaw articulations can be restored with a high degree of probability. The size of the brain case is more doubtful, but it was probably at least of the type of the Neanderthal skull (see page 234). The jaw is of truly remarkable size and strength and entirely apelike in form, especially in the absence of a chin, but the teeth are altogether human and small as compared with the size of the jaw.

Of very great antiquity, perhaps of 500,000 B.C., are the fragments of a skull (2) discovered at Piltdown, England, in conjunction with a number of flints and fossils—and a jaw which is still a matter of controversy. The skull and head of this Piltdown man have been restored by Professor McGregor (3, 4, 5). Number 4 shows a preliminary stage in the restoration of the soft parts of the head with clay cylinders attached to indicate the thickness of the flesh. Number 1, near the center of the case, shows casts of two eoliths, the most primitive form of rude stone implement and a primitive Palæolithic flint implement found in strata immediately above and around the fragments of the Piltdown skull; at 1, near the end of the case, are other flint implements found at Piltdown. Numbers 6, 6, 6 mark a collection of very primitive stone implements rudely edged or pointed. A feature of the Piltdown skull which distinguishes it from those of the Neanderthal type is the absence of eyebrow ridges. Although this is the most primitive and apelike human skull that has been found, it is nevertheless well advanced along the line of characteristically human evolution and shows a brain capacity estimated as at least between 1200 and 1300 cc., equaling or exceeding that of the aboriginal Australians

THE IMMEDIATE PREDECESSOR OF MODERN MAN, THE NEANDERTHAL RACE

Photograph of Case III in the hall of the Age of Man, the American Museum, showing man of the Neanderthal type, in the Middle Old Stone age in Europe, from about 50,000 to 25,000 B. C. (Mural I of the human series, in the hall of the Age of Man, "The Neanderthal Flint Workers," is incomplete and a photograph cannot be presented at this time. The completion awaits the restoration studies, by McGregor, of the Neanderthal body.)

A race of long-headed men was established over western Europe before the last (fourth) Glacial period. Many of their stations have been discovered and a considerable abundance of fossil material, including practically complete skeletons. These represent what is probably a distinct species of man (*Homo neanderthalensis*), presenting some features never before found elsewhere combined in any human race and some quite outside the limits of variation of recent man. Number 1 marks a cast of the skullcap which constitutes the type of this species. The original was discovered in the Neander Valley, near Düsseldorf, Germany, in 1856; at 2 (upper) is a cast of a Neanderthal-like skull discovered at Spy, Belgium; while below this (2, lower) are casts of fragments of jaws from Malarnaud, France. Fragments of very ancient jaws from Krapina, Croatia, are shown in No. 3. These last date from the last Interglacial stage and represent a culture (Acheulean) which preceded the culture (Mousterian) of the typical Neanderthals. The skull found at Le Moustier (France) (4) is thought to be that of a youth of about sixteen years. Number 5 is a cast of a Neanderthal skull from La Chapelle-aux-Saints (France) with the superficial injuries corrected and the nasal bones, alveolar region, and the teeth restored. The three casts numbered 7 are respectively, from left to right, the female Neanderthal skull found at Gibraltar in 1848, a restoration of the same, and a reconstruction of half of the soft parts of the head. The lower jaw was restored from studies of ten other Neanderthal jaws. Number 8 shows stone implements of the so-called *coups de poing* type. The ovaloid forms with sharp edges may have served for knives, while the disk-shaped stone was probably a scraper. To the right of these implements are casts of twelve teeth discovered in 1910 on the Isle of Jersey in the English Channel. The central bust (6) is a restoration modeled by Professor McGregor on a replica of the Neanderthal skull by its side (5)

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

CRÔ-MAGNON ARTISTS OF SOUTHERN FRANCE (MURAL II)

The work of arrangement is in progress on Case IV in the hall of the Age of Man, but is too incomplete to allow presentation of a photograph. Case IV will show the Crô-Magnon race at the climax of the Old Stone age. The mural of the Crô-Magnon artists, however, in the middle of the north wall, is completed, as shown above

Contemporaneously with the disappearance of the last Glacial period in Europe, a highly evolved race in no respect inferior to modern man entered that continent from the east and drove out or exterminated the Neanderthal race, of which they were both the mental and physical superiors. Their cultural capacity is indicated not alone by their physiognomy and the cubic content of their brain (see bust at the right on page 229), but has also been demonstrated by the handiwork and especially the artistic productions which they have left in the caves of southern Europe. The Palæolithic murals and sculptures in relief found on the walls of limestone grottoes in France and Spain indicate greater artistic sense and ability than have been found among any other uncivilized people. The mural above, painted by Knight for the hall of the Age of Man, represents four Crô-Magnon artists at work on the famous procession of mammoths as found in the cave of Font-de-Gaume, Dordogne, France. The two half-kneeling figures are holding lamps made of hollowed-out stones. The artist standing half erect is engaged in incising the outlines of a mammoth on the limestone wall with a sharp flint; the other artist is laying on the colors, employing a shoulder bone for a pallet. The kneeling figure is preparing colors from red or yellow ochre. The clothed man to the left is a chieftain who carries a *baton de commandement* on his staff as an insignia of his rank from any modern human type, it must be studied from models of its own. The group is very carefully arranged to show the physical characters of this man: the knees slightly bent in the peculiar standing posture, the broad heavy shoulders slightly stooped, and the massive neck and the head set well forward. In the background is the famous cavern of Le Moustier which gives its name to the Mousterian period of flint industry pursued by the Neanderthals.

The Crô-Magnon Race of High Type

The highly evolved Crô-Magnon race entered Europe from the east and drove out the Neanderthals. This was a race of warriors, of hunters, of painters and sculptors far superior to any of their predecessors. The original type of the Crô-Magnon head belonged to an aged individual. We are now endeavoring to secure from France replicas of the Crô-Magnon skeletons buried in the grottoes of Grimaldi near Mentone, which are by far the most perfect known. The contrast between the Crô-Magnon heads and those of the Neanderthals which precede them is as wide as it possibly could be. The Crô-Magnons were people like ourselves in point of evolution, and the characters of the head and cranium reflect their moral and spiritual potentiality.

Crô-Magnon Artists Painting the Mammoth (Mural II)

One of the great murals in the hall of the Age of Man (over the doorway opposite the Crô-Magnon exhibit) represents four of the Crô-Magnon artists actually painting the great fresco in the cave of Font-de-Gaume, Dordogne, France. The writer has been studying the composition of this group for years, with Mr. Charles R. Knight, artist, aided by advice of the Abbé Henri Breuil of the Institut de Paléontologie Humaine, Paris, as well as of Mr. N. C. Nelson, archæologist at the American Museum of Natural History.

There are six figures in the group; four are depicted partly nude to show their anatomy in contrast with that of the Neanderthals. The two half-kneeling figures are holding up small lamps to illuminate the smooth surface of the limestone wall on which the procession of mammoths is being depicted. The half-erect figure represents an artist with pointed flint incising the outlines of a mammoth on the wall. The fully erect central figure represents an artist laying on the colors. A kneeling figure is preparing the colors on a rock. The artists and their assistants have laid off part of their fur clothing in order to work more freely. This design enables the painter to show the tall, slender proportions of the men of this Crô-Magnon race. The standing figure to the left is that of a chieftain clothed in well-made fur garments, who carries on top of his staff his *baton de commandement* as the insignia of his rank. The only illumination is that of the flickering wicks in the small oil lamps.

Men of the New Stone Age

Men of the Neolithic, or New Stone age (see remains shown in Case V, the arrangement of which, however, is only in progress so that a photograph cannot be presented) used stone implements, partly chipped, partly polished. They hunted with the wolf dog. They brought in pottery. In central and southern France and in Switzerland they cultivated the ground and introduced cereals. Forerunners of these Neolithic men scattered over the Baltic shores and reached northern France.

The Neolithic Stag Hunters (Mural III)

This mural group also is in its place in the hall (at the west end), having been completed in 1919. It represents men of a northern race,

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

"THE NEOLITHIC STAG HUNTERS," OF THE NEW STONE AGE (MURAL III)

Case V, in the hall of the Age of Man, illustrating the types and culture of the men of the New Stone age, is in process of arrangement and cannot yet be photographed

The progenitors of contemporary man in Europe, through a transition period between Palæolithic and Neolithic times (about 7000–1500 B.C.), introduced a new culture of polished stone and crude pottery, and either absorbed or displaced their upper Palæolithic predecessors. This mural, "The Neolithic Stag Hunters," now in place in the American Museum, at the middle of the west wall of the hall of the Age of Man, portrays the end of the hunt at an encampment on the border of one of the northern beech forests. The hunters with their stone-tipped spears are resting after the chase and have thrown aside parts of their fur garments. These Neolithic invaders were a powerfully built people with brown or fair hair and narrow heads—closely related to existing peoples of Scandinavia. The rigorous climate little encouraged the fine arts, but promoted endurance, tribal loyalty, and the rudiments of family life. Rude huts were constructed to take the place of caverns and shelters, but the most important cultural change was the introduction of a rudimentary agriculture with the use of a variety of plants and seeds. The men of the New Stone age also brought with them, or domesticated from the animals they found in western Europe, many of the same types of animals as are domesticated today, and they may possibly have been attracted to Europe by the abundance of horses of the forest and Celtic types. The chief's fair-haired son in the picture is shown leading a wolf dog, the ancestor of the sheep dog of northern France brown- or fair-haired, hunters of the stag, living along the southern shores of the Baltic in the earliest stage of the New Stone age, a stage known as the Campignian from remains of huts and rudely polished stone implements found near Campigny in France. The scene is on the border of one of the northern beech forests and represents the return from the hunt. After the ardor of the chase the hunters have thrown off their fur garments. The chieftain in the center is partly clad in furs; in the coming winter season he will be wholly fur-clad. His son, a fair-haired youth with a necklace of bear claws, grasps a bow and arrow and holds in leash a wolf dog, ancestor of the modern sheep dog of northern France. The hunters, with spears tipped with stone heads, are resting from the chase. Two vessels of pottery indicate the introduction of the new ceramic art, accompanied by crude ornamentation.

This race was courageous, warlike, hardy, but of a lower intelligence and artistic order than the Crô-Magnons; it was chiefly concerned, in a rigorous northern climate, with the struggle for existence, in which the qualities of endurance, tribal loyalty, and the rudiments of family life were being cultivated. Rude huts take the place of caverns and shelters, which are now mostly abandoned.

These were tall men with high, narrow skulls, related to the existing Nordic race, more powerful in build than the people of the Swiss Lake Dwellings. Skulls and skeletons representative of this hardy northern type are abundantly known in Scandinavia, but have not found their way to our American Museum collections as yet.

The Great Mammals Hunted by Man

The hall of the Age of Man is planned to contain four chief collections of the mammals of the world during the period of the Age of Man.

In Europe man hunted the reindeer, the wild horses and cattle, and the mammoth. He used the hide of the reindeer for clothing, the flesh and marrow for food. He carved the ivory tusks of the mammoth. The mammoth, the northern, hairy type of elephant known to early explorers of fossil remains, was foremost among the great mammals hunted by man. The whole history of this proboscidean order is shown in the hall of the Age of Man.

The evolution of the proboscideans culminates in the mastodons and mammoths. This is one of the romances of evolution quite equal in interest to the evolution of the horse. This collection is by far the most complete in existence; it contains as much in the way of complete skeletons as those in all the other museums of the world combined. The early stages in the evolution of the proboscideans, beginning with the *Palæomastodon* discovered in the Fayûm region of northern Africa, carry us back into times far antecedent to the Age of Man, namely, into an early period of the Age of Mammals, the Oligocene. It has been deemed wise to collect here the entire history of the evolution of the proboscideans, which taken altogether is the most majestic line of evolution that has thus far been discovered.

Murals of the Four Seasons in the Glacial Epoch

The four great murals just completed on the north walls of the hall of the Age of Man represent scenes during the four seasons of the year near the close of the Glacial epoch in the Northern Hemisphere.

These four seasons belong in the same period of geologic time, namely, the final glacial stage, the period of the maximum advance of the glaciers over the entire Northern Hemisphere, of the most intense cold, and of the farthest southward extension of the northern types of mammals. This is

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

THE WOOLLY RHINOCEROS IN A GLACIAL WINTER, NORTHERN FRANCE

This mural from the hall of the Age of Man, the American Museum (on the west wall, at the right), and the three following (pages 241 and 245), represent the four seasons of the year in the Old Stone age, near the close of the fourth Glacial period. This was the period of greatest glacial advance over the Northern Hemisphere and of the most southerly extension of the northern types of mammals; it was the time of the Crô-Magnons in Europe from whose paintings we derive knowledge of the mammoth, reindeer, and rhinoceros which then flourished

The most common of the many extinct rhinoceroses is the *Rhinoceros antiquitatis* or woolly rhinoceros of Europe and Siberia. This species was most like the square-mouthed or white rhinoceros of Africa nearly extinct today. It was protected from the wintry blasts by a heavy coat of long hair and a thick undercoat of fine wool. This brown wool was found in a good state of preservation on the side of the face of one specimen discovered in the ice fields of Siberia, and is now in the Museum of Petrograd. In the distance can be seen a group of mammoths and a line of saigas—an extinct species of antelope. The rhinoceros kept closely to the ice sheet and never wandered so far south as did the mammoth. It was a plains dweller, living on grass and small herbs the time of the Crô-Magnon race, and our knowledge of the mammoths, reindeer, and rhinoceroses is derived from the actual Crô-Magnon paintings and etchings, chiefly those found within the caverns. The murals of the four seasons are as follows:

Midwinter.—The woolly rhinoceros in northern France.

Early Spring.—The reindeer and mammoth on the river Somme, France.

Midsummer.—The mastodon, royal bison, and horse on the Missouri River, in the latitude of Kansas.

Autumn.—The deer-moose, tapir, and giant beaver, in northern New Jersey.

The Glacial Winter in Northern France

The woolly rhinoceros, like the woolly mammoth, was heavily enwrapped in hair, beneath which was a thick coat of fine wool. With this protection the animal was quite indifferent to the wintry blasts which swept over the steppe-like country of northern France. This golden brown wool is actually preserved on the side of the face of one specimen discovered, which is now in the Museum of Petrograd. The head of the rhinoceros was long and narrow, like that of the white rhinoceros of Africa, but the jaws were narrower and the upper lips were more pointed. It is an animal quite distinct from the great black rhinoceros still extant in Africa, which is a grazer with broad lips. In the distance in the painting are shown the saigas, antelopes which wandered over France at that time, and a group of woolly mammoths.

Spring on the Somme River in Northern France

The scene represents the two herds, reindeer and mammoth, migrating along the banks of the river Somme not far from one of the great encampments of men of the Crô-Magnon race. These reindeer and mammoths are, in fact, depicted very precisely in the paintings and engravings left by the Crô-Magnon artists—especially in the cavern of Font-de-Gaume. It is a striking fact that, in the case of the mammoth, every painting, drawing, etching, and model which the Crô-Magnon man has given us exhibits exactly the same characters: the long hairy covering, the very high hump above the forehead, the notch between the hump and the neck, the very high shoulders, the short back, the rapid slope of the back over the hind quarters, the short tail. There is no doubt that aided by these wonderful Palæolithic designs, the artist, Mr. Knight, has given us a very close representation of the actual appearance of the woolly mammoth.

Summer on the Missouri

The summer scene on the Missouri River (on the parallel of Kansas) represents the region south of the farthest advance of the ice sheet. The mastodons are grouped in such a manner as to show the characteristic low, flattened head, the long low back, the symmetrical fore and hind quarters, the extremely short, massive limbs, and the very broad and massive hip region as seen from behind. In the center of the picture stands the majestic *Bison regius,* the royal bison, known only from a skull, a superb specimen, with the horn cores attached, in the collection of the American Museum. These animals were like gigantic buffalo or bison, beside which the modern buffalo would appear very diminutive. The characters of the hair and wool are not known, but it is assumed that they were similar to those of the existing buffalo, since the paintings of the bison by the Crô-Magnon artists in France all show the distinctive beard below the chin. At the right is a group of wild American horses of the period, the last of their race in this country; the

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

Early spring—"The Reindeer and Mammoth on the River Somme, France" (mural on the north wall, at the left).—It is thought not improbable that herds of mammoths, rhinoceroses, and reindeer migrated northward and southward with the seasonal changes. This mural represents a northward march in the spring. As the mammoth was faithfully depicted by the Crô-Magnon artists—especially in the cavern at Font-de-Gaume (see page 235), and as mammoth skeletons have been well preserved, there can be little doubt that the present representation by Knight is a close likeness of this huge proboscidean. The woolly mammoth resembled greatly an Indian elephant but was somewhat larger, was covered with coarser hair, and had larger and differently curved tusks. Whole carcasses of these beasts have been found frozen in the ice fields of Siberia where they probably survived later than in Europe

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

Midsummer—"The Mastodon, Royal Bison, and Horse on the Missouri River, in the Latitude of Kansas" (mural on the north wall, at the right).—This mural presents a summer scene in a region of North America south of the farthest advance of the ice sheet. The great mastodon (left) with flat, elongated head and extremely short massive legs survived in America to a time contemporary with man in Europe, but no mastodons lived in Europe at such a late period. In the center of the picture are seen the royal bison (*Bison regius*), the gigantic forerunners of our present bison. At the right is a group of the last species of native American horse (*Equus scotti*) which disappeared before the appearance of man on the North American continent

Detail of American Museum mural by Charles R. Knight. Copyrighted photograph

A MASTODON PORTRAIT

The short-legged, flat-headed mastodon is strongly contrasted in form with the mammoth (compare in the murals on the preceding page). The proboscidean collection in the American Museum is the most complete in existence. It shows that the story of development of this majestic and intelligent line of mammals is one of the romances of evolution, comparable with the evolution of the horse. The earliest elephant ancestry, beginning with the Fayûm *Palæomastodon* discovered in northern Africa, leads to a time greatly preceding the Age of Man, far back at the beginning of the Age of Mammals

Detail of American Museum mural by Charles R. Knight. Copyrighted photograph

PORTRAIT OF A MONARCH OF AN EXTINCT RACE

The "royal bison" (*Bison regius*) ranged the plains of America at the time of the last Glacial period and the Old Stone age of man. The species is known only from a skull in the American Museum.

The half-tone reproductions accompanying this article have had to be so greatly reduced that they give no idea of the impressiveness of the murals in the hall of the Age of Man as a result of their stupendous size. Each of those shown on page 241, for instance, measures in the original wall painting nearly 30 feet in length and 10 feet in width. Also, the reproductions are inadequate because of the failure to carry the beauty of color of the originals and the impressiveness due to the artist's successful handling of light in connection with landscape and animals. The four seasonal murals on the north walls are unified by a noticeable blending in atmosphere from the cold, bleak coloring of winter, through early spring with the glow of a low sun over snow and rocks, into the green and brown of summer, thence into the warm, rich foliage and reflections of autumn species is *Equus scotti,* the skeleton of which has been discovered in northern Texas.

Autumn in New Jersey

The autumn scene in northern New Jersey embraces three very distinctive North American types of the period, all of which have become extinct. The deer-moose (*Cervalces*) (to the left) was described by Professor W. B. Scott, of Princeton, from a single skeleton found in the gravel beds of northern New Jersey, which is now preserved complete in the Princeton Museum. The American fossil tapir (in the center) is known from sparse remains, the best of which were among the earliest discoveries of the pioneers of American palæontology. The giant, beaver-like animals of the genus *Castoroides* (see two individuals at the right in the painting) are known from nearly complete skulls and skeletons discovered in Ohio and other central western states. They are not true giant beaver.

The remaining mural of this series will represent a scene in southern California, in the vicinity of the Rancho-la-Brea deposits, including the remains of the astonishing group of animals caught in the asphalt trap, so splendidly represented in the collection of the Museum of History, Science, and Art, of Los Angeles.

Closely Related North and South American Mammals of the Glacial Epoch

The most characteristic animals of North and South America that lived during the Age of Man (see the south side of the hall) are known through some of the unique remains from the famous deposits of Rancho-la-Brea of southern California, especially the sloths, saber-toothed tigers, and wolves of the period—to which it is hoped that we may add some of the less abundant forms, like the camel and the horse. So far as possible, through exploration and exchange, this quarter section of the hall will represent the mammalian life of North America, in contrast with the mammalian life of South America during the same period of time.

The Museum is also extraordinarily rich in the great Pampean Collection presented by certain of the trustees in 1899. This collection shows the close connections between North and South America in glacial times.

One of the most wonderful fossil groups in the Museum, if not the most wonderful, is the sloth and glyptodont group (center of southern side of the hall of the Age of Man). This group is still in preparation. It includes five sloths of two varieties (the *Mylodon* and *Scelidotherium*) and three glyptodonts. These animals, so entirely different in external appearance and habits, nevertheless belong to the same order of mammals, the Edentata, which, as its name implies, is distinguished by the absence of enamel on the teeth. It is important to bring these two animals together in the same exhibit, so as to show the very wide contrasts in adaptation which may occur within the limits of a single mammalian order: the sloths covered with long hair and with vestiges of armature embedded in the skin, the glyptodonts nearly hairless, and encased in powerful bony armature, which renders them completely immune to attack by the saber-toothed tiger of the period.

A Loess Storm on the Pampas of Argentina

A mural on the western wall (at the left) of the hall of the Age of Man presents a South American scene during the Old Stone age. It depicts the ancient pampas of Argentina with the winding river La Plata in the background, and a typical extinct mammalian fauna. See page 246 for these animals, which furnish a key to the arrangement of the sloth-glyptodont group described above.

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

AUTUMN IN NORTHERN NEW JERSEY DURING LATE GLACIAL TIMES

This mural (on the east wall, at the left) presents three extinct North American animals: the deer-moose or *Cervalces* (at the left), the tapir (center), and a great rodent, *Castoroides* (on the right). The rodent, much larger than a beaver, dwelt in the northern swamps. Its nearest relative is a large coypu rat of South America. The *Cervalces* had antlers neither as branching as those of the elk nor as flattened as those of the moose. An almost complete skeleton has been recovered from the gravel beds of New Jersey. Tapirs were at one time widely distributed, particularly over the Northern Hemisphere, but are now found only in restricted and widely separated more southerly regions.

The mammalian life of North America, as contrasted with that of South America during the same period of time, will be illustrated in a section of the hall of the Age of Man. The most characteristic animals of this Age—sloths, saber-toothed tigers, wolves, camels, and horses—have been taken from the deposits of Rancho la Brea in southern California, where they were caught and preserved in the asphalt quagmires

Painted by Charles R. Knight, under the direction of Henry Fairfield Osborn. Copyrighted photograph

A LOESS STORM ON THE PAMPAS OF ARGENTINA

A mural of South American mammalian life of the Old Stone age, in the hall of the Age of Man (on the west wall at the left)

In the distance a violent storm is transporting columns of loess or fine dust (of which extensive fossil-bearing deposits are found in various parts of the world). The scene is laid along the banks of the La Plata River where many great fossils have been discovered buried in the loess. In the foreground are two very different extinct species of edentates, a family which includes the armadillo, anteater, and sloth. Those with armor at the right are glyptodonts; the long-haired ones at the left are mylodonts. In the background at the right are shown a number of macrauchenias, a three-toed, hoofed animal, while at the left are seen the rodent-like toxodonts, ungulates or hoofed animals also but as large as rhinoceroses. The American Museum has an unusually fine fossil collection from the Pampas, showing the close connection between North and South America in glacial times

The Birth of a Science

Recognition of the similarity of geological processes in the past with those we now see in action, and an evolutionary conception of the earth's history, are leading the human mind into realms of philosophy heretofore undreamed of and revealing secrets which seemed eternally hidden

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I

AFTER speculating upon the probable origin of the world it was but natural that men should ask whether it has remained the same from the beginning, or whether, like everything else we see, it too has been subject to the dominion of unceasing change. What is human history but a record of the rise of empires, their brief tenure of power and eventual fall into insignificance or nothingness? Is it possible, then, that the old earth has experienced similar vicissitudes, that mountain and fertile plain have alike risen from beneath the waste of waters, and that continents upon which flourished the civilization of ancient races have long since been submerged?

What the answer to these questions will be, will depend, to a considerable extent, upon the theorist's cosmological ideas. It is therefore essential, if we would appreciate the development of our knowledge of earth history, to pass in review the various conceptions of the beginning of things which from time to time have been held. While these theories are apparently without number, it will be seen that they belong essentially to five classes. First, it may be that there has been no beginning, but that on the contrary, the world has always existed; second, the world may have come into existence in the form which is now so familiar to us; third, in its present form, the world may date back to the chaos to which a former creation had been reduced; fourth, to arrive at the beginning we must trace back an apparently infinite series of kaleidoscopic combinations; and fifth, the familiar earth is but the present and temporary phase in an evolutionary chain whose initial link was forged when the universe first stood forth, and whose last link will have been reached when the force which was then concentrated within it, will at length have all been dissipated.

It is then apparent that any system of the earth's history will be based upon one or another of these five underlying philosophical concepts which have been successively adopted and discarded as the body of verified fact available has become increasingly adequate. Among the influences which have thus helped to shape the development of human knowledge, and make it possible to mold the heterogeneous mass of geological fact into one connected whole, there stand preëminent two great discoveries, the organic origin of fossils and the historical uniformity of the geological processes. Let us trace the slow acceptance of these discoveries, and mark their influence upon the birth and progress of the science of geology.

II

The earlier conceptions of the earth and its history, based, as they necessarily were, upon hypothesis, and not upon a knowledge of the laws of nature, were guesses rather than scientific deductions. Yet, when we seek to follow the development of the science, we must consider these earlier stages.

as well as the well-reasoned results of modern scientific investigation.

The primitive idea is, no doubt, that the earth has always been the same, and indeed we still sometimes speak of "the everlasting hills." The span of human life, when compared with the cycles of nature, is so brief that the observations of the most aged patriarch and the traditions of the race alike fail to tell us of any change in the familiar features of the landscape. It is then but natural to suppose that the changeless earth is eternal and that

> "The past is an unfathomable depth,
> Beyond the span of thought."

But while many philosophers may have found it impossible to conceive of the creation of the world, there have always been, in the mythologies of primitive peoples, stories of the beginning of things. Combining, then, the two ideas of creation and the changeless earth, there arose the conception that the earth came into existence full-grown and so perfect that no subsequent change was necessary. But, if it were eternal, or even if it has been changeless since its inception, the problem of its existence is beyond human comprehension, and the phenomena of the earth—the data of geology—have but a passing interest, and those deep questions which perplex the human mind are eternally unanswerable.

III

One important discovery, however, repeatedly made and successively forgotten, proves, when its true significance is realized, that the earth has had a history the records of which can still be read. This discovery was that, within the solid rocks of the earth's crust, there lie imbedded the remains of the animals and plants which in an age long past lived upon its surface, and that these remains form the documents from which the story can be reconstructed. This fact was known to Xenophanes, of Colophon, more than twenty-five centuries ago, and in all succeeding ages there were men of vision to observe it and to draw from it the correct deductions. But these conclusions had little influence in their own generation and were soon forgotten. In an uncritical age, characterized by unregulated speculation, it is not surprising that no more attention should be paid to scientific deduction logically drawn from verified data than is given to the wildest theorizing based upon untrue statement of fact, or no fact at all. And so it happened that many centuries must pass before the world could realize the importance of this fact, or the conclusions to be drawn from it.

The theory that these strange objects found in the rocks were the actual remains of animals which had lived long ago met with great opposition from men of conservative or prejudiced minds. Many and ingenious were the alternative explanations. Avicenna, the Arabian philosopher in the eleventh century, following the theory of Aristotle that nature is constantly producing living organisms from inorganic matter, supposed that in this process there were many abortive attempts, and that what we now call fossils are the agglomerations of atoms on the way to becoming living things, but by some defect in the carrying out of the plan, they will never be able to attain their goal. This idea, under various forms, notwithstanding the arguments of more enlightened men, persisted down to the middle of the eighteenth century. Fossils, the philosophers told us, might be considered as earthy concretions, as the product of some mysterious seeds of life in the vapors which rise from the sea, as the result of the force of crystallization, as the consummation of the influence of the stars, but as organic remains—never.

Some philosophers, indeed, saw in these strange markings in the rocks, the literal handwriting of God himself. And since they believed that Hebrew was the primitive tongue of man and undoubtedly the tongue spoken in heaven, it necessarily followed that, if we could decipher these cryptic words, they would be found to be written in that ancient language. Most successful of all the investigators who followed this line of research was Professor Beringer, of the University of Würzburg, who led his wondering students to the various outcrops in the neighborhood, and found Hebrew characters of progressively clear and distinct form. These were set forth in his learned monograph called *Lithographiæ Wirceburgensis* [1726]. But there is a limit to the extent to which even such minds as these can go, and on one dark day he discovered a rock containing a series of Hebrew letters even clearer than ever before, which as he spelled them out, to his amazement, proved to be those of his own name. The difficultly disguised amusement of his class, and the astonishing nature of his discovery at length revealed to him the fact that he had been made the butt of a practical joke, and with a heavy heart he hurried home to write to his publishers to stop the issue of that ill-fated monograph which, he had hoped, was to have brought honor and recognition to its author. But it was too late. The work now remains as a memorial to the heights of absurdity which can be achieved by those who base their work upon preconceived ideas rather than upon verified data.

As the reality of the organic origin of fossils was gradually admitted on all sides, the men of the opposition took another line of defense. In the undoubted evidences of a submerged land surface they saw the results of the universal deluge as described in the book of Genesis, and they thought that by combining the description contained in that book with such scientific facts as might serve their turn, a complete and satisfying system might be constructed.

Among those who sought thus to discover a connected "Theory of the Earth," were Burnet and Woodward. Their works, often elegant in style and displaying great erudition of a kind, are now mere literary curiosities and the examples of the product of a peculiar mental myopia which can see clearly those facts that may be used in support of a theory, but is blind to all others.

The first of these, *The Sacred Theory of the Earth* (1681), by Dr. Thomas Burnet, is described in the brilliant, yet caustic words of Goldsmith as "well known for the warmth with which it is imagined, and the weakness with which it is reasoned; for the elegance of its style, and the meanness of its philosophy." Dr. Burnet pictures for us an earth before the deluge, composed of the various materials which we now know, but all arranged in the order of their respective densities: first, the heavy and fiery center; next, the rocks of less weight and less heat; then, encompassing and covering them, the world of waters; on the face of the water a layer of oil, and around all, the atmosphere. In these primitive times the air was full of dust and other impurities which gradually were cleared out by the falling rain and formed an emulsion with the layer of oil, thus producing a solid and perfectly flat and unbroken plain, upon which the newly created beings found their home. This was paradise, a world of even regularity, unbroken by the displeasing forms of crag or precipice or mountain peak, a world appealing to the precise formalism of the eighteenth-century mind.

But gradually this ideal world became polluted by the crimes of the antediluvians, crimes which called down upon them the wrath of the

Almighty. The punishment consisted in permitting nature to take her course. The sun beating down upon the moist earth produced great cracks and crevices, which were not allowed to close. As these chasms increased in size the great abyss of subterranean waters was set free. Gushing out, it overwhelmed the land. This tremendous cataclysm, the universal deluge, brought with it its own cure, for as the waters rushed out, vast quantities of air were sucked in, and the underlying rock became full of great and yawning caverns. Into these the waters again subsided and little by little the mountain tops and finally the dry land itself reappeared.

John Woodward, who followed him, had this advantage, that he was not entirely unacquainted with the facts of nature. These facts, however, could apparently be used or ignored as the exigencies of the argument required. The earth, says our author, is built up of a great number of layers of various densities, but all disposed in regular order, the heaviest at the bottom, the lightest at the top. This arrangement must have been the result of a slow precipitation of the materials of which the rocks are composed from a primitive state of suspension in water. The vast amount of water necessary for this process was, no doubt, that which we read covered the earth when the windows of heaven were opened, in the days of Noah, and was with equal certainty supplied by the tail of a comet, through which aqueous envelope the earth at that time made its way.

But a difficulty arose. The fossils in the rocks were at length being recognized as the remains of extinct animals, and their presence in strata so recently formed required an explanation. Whatever one may say about the absurdity of Woodward's explanation of this stubborn fact, there can at least be no question as to its ingenuity. These fossils, said he, were already in the rocks at the time of the flood. The solvent qualities of so great a mass of water were sufficient to disintegrate all previously existing strata, but not the fossils themselves. These objects, possessing a special impermeability to water, remained intact, and when the immense amount of material in the waters was again precipitated, the fossils regained their old position.

Thus the facts of geology, at one time suspected of being subversive to the statements of Holy Writ, were now being made to fit in with geological theories based upon the then current ideas of what those statements really meant. Those philosophers whose systems were antagonistic to revealed religion were in consequence driven to discover another explanation for the occurrence of shells on the highest mountains. These, the learned world was informed, were the palmers' shells fastened upon the headgear of pilgrims returning from the Holy Land. In the gales which so constantly blew across the Alpine peaks, we have the reason for the loss of so many shell-encrusted caps, and the existence of shells so far above the level of the ocean, was thus easily explained.

IV

But a better day was even then dawning. Amid all these absurdities certain great facts were emerging. Fossiliferous rocks were becoming recognized as the documents from which the earth's history must be written. And it was admitted that they indicated a life upon the earth in a previous age, very different from that which we now see about us. The astonishment with which these remains were viewed by their first discoverers is indicated by the name which they gave to one of them—Paradoxides.

A study of these long extinct but once living things, gave rise to the conviction that there have been two worlds, that which we now know, and the antique world, which they called "pre-Adamic," and which was populated by races of animals, some of them of colossal size and strange and bizarre appearance. Between these two worlds there had been a great gulf fixed, a gulf of annihilation. The ancient world had been destroyed and on its ruins there had been created the new and better one we know.

But as knowledge of fossils increased, it was realized that not only once but many times had the population of the earth completely changed. So the theory was expanded and the history of the earth was conceived as the record of successive creations, each differing from that which went before and from that which followed, and each in turn destroyed as a sum is wiped off the slate by a wet sponge. It was at these times of crisis, according to this hypothesis, that the great ranges of mountains had come into existence. This strange philosophy of the world, to which the name "catastrophism" was applied, was widely accepted at the beginning of the nineteenth century.

The theory of catastrophism, however, was soon seen to rest upon very insecure foundations. The great breaks which men thought they saw occurring between the life of succeeding formations grew narrower and finally disappeared altogether as the rocks of other lands were studied. In the strata of each period there were found the remains of species which had characterized the rocks of the immediately preceding age, and even among the beasts which roamed the earth before man appeared and which have now become extinct, there were those, as for instance the mammoth, which remained long enough to be hunted by our primitive ancestors and to have their forms delineated upon the walls of the hunters' caves.

V

Thus, world history at length stood revealed as a great and satisfying unity. Since the beginning, seed time and harvest had not failed. The operations of nature had never been completely interrupted, but had ever been subject to some great law in the working out of the underlying plan of the ages.

What this law was, and what the plan upon which the world had been wrought, was the object of research of James Hutton, physician, farmer, man of means, of Edinburgh in the later years of the eighteenth century, one of the great original geniuses who have laid the foundations of modern science. In his method he differed from those who went before him, for instead of obtaining his information from the writings of the ancients, he went direct to nature.

When this appeal was made, how different were the results obtained. In the flowing of the river, in the dashing of the waves upon the shore, in the wash of the raindrops, in the silent action of the frost, he saw the forces which are wearing down the uplands and carving them into the thousand irregular forms of mountain scenery. He also saw that the basalts laid away amid the layers of other rocks beneath our feet, were not, as was then generally believed, solidified sediments, but the lavas of an earlier day. Finally, he believed that the mighty forces revealed in mountain formation had been exerted slowly and imperceptibly, in exactly the same manner as the gradual changes in level, which apparently are taking place now in various parts of the world.

The earth is thus constantly changing. Its present condition is the result of those forces which we now see everywhere in action, and is but the momentary and evanescent link of an endless chain. As he looked back across the ages, he could see no force adequate to set these changes in motion, and as he looked forward he saw no reason to suppose that they would ever cease to be.

This new theory of the earth, given

to science in the year 1795, formed the foundation upon which has been erected the modern structure of geological knowledge. On account of its insistence upon the similarity of the geological processes in the past with those which we now see in action about us, it has become universally known as the "Uniformitarian Theory." It is this which has made it possible to create out of the heterogeneous mass of disconnected fact, a noble science which is leading the human mind into realms of philosophy heretofore undreamed of, and revealing secrets which seemed eternally hidden.

It was but natural that the propounder of this theory, which may now justly be elevated to the rank of a law of nature, as well as those who subsequently elaborated the system and by their illustrations achieved its general adoption, should have pressed its application a little too far. Moreover, the increased interest in the science which resulted from the discovery of this unifying law, brought to light many pertinent facts, which rendered necessary a restatement of some of its clauses. Consequently, certain modifications or reservations have been accepted to bring the theory into harmony with more recent geological knowledge. In the first place it has been found that the great upheavals of the earth's surface have taken place intermittently: that mountain formation has occurred always as the climax of long continued and imperceptibly slow elevation of the land, and that those times when mountains were born, which also were marked by intense volcanic activity, recurred periodically with a certain mysterious rhythmical regularity. In the second place it is becoming clearer that geological history is not a regular recurrence of like events, but a progressive change. The world of long ago, whose story we read in the rocks, was a very different world from that in which we now live, and in the world which is to be, the mountains, the lakes, the rivers, the familiar landmarks of today, will have again passed into oblivion.

These modifications of the uniformitarian theory, while they do not alter it in any essential particular, still give it a philosophical color which its author, no doubt, scarcely anticipated, and lead to the last or evolutionary conception of earth history. Thus modified, the theory pointed the way to a new revelation of the rocky strata. We now see in them the record of a progressive development, which characterized not only the earth's geographical features, but also to an equal extent the forms of plant and animal life which found their home upon its surface. Far back in the distant past there was a beginning, and some day in the distant future, the energy which was concentrated in our solar system will finally have become radiated into space and have disappeared.

VI

To have constructed a history of the earth from records at once so undecipherable and so fragmentary as those we find in the rocks, is one of the greatest triumphs of human genius. To this achievement, as we have seen, two great discoveries have contributed, the knowledge of the nature of fossils and the uniformitarian law. But this history is not yet complete. Each year the body of data from which it is being reconstructed becomes fuller. New discoveries of the most vital importance are constantly being announced. Gradually the story in its completeness is being revealed to us, so that we may, in the words of King Henry IV,

> "read the book of fate,
> And see the revolution of the times
> Make mountains level, and the continent,
> Weary of solid firmness, melt itself
> Into the sea! and, other times, to see
> The beachy girdle of the ocean
> Too wide for Neptune's hips; . . ."

John Campbell Merriam: New President of the Carnegie Institution

By W. D. MATTHEW

Curator of Vertebrate Palæontology, American Museum

JOHN C. MERRIAM is professor of palæontology in the University of California, chairman of the Division of States Relations of the National Research Council, a leading authority on fossil vertebrates, and a remarkably successful organizer of scientific research. It is in this last and highest capacity that he is now serving and will render his most important contributions to the progress of science.

He was born in 1869 at Hopkinton, Iowa, graduated at the University of California, and took his doctorate at Munich in 1893 under Zittel. He returned to the University of California the next year as instructor in palæontology, was appointed assistant professor in 1899, associate professor in 1905, and full professor in 1912.

The palæontology of California and the Pacific Slope afforded a vast and little-known field for exploration and research. Merriam attacked this problem with remarkable success, due to systematic and persistent work and close coöperation with geological research. He trained a staff of able and energetic assistants, inspiring them with his own enthusiasm and broad ideals, and organized and directed their work with marked executive ability.

The result of these explorations during the last twenty years has been to bring to light a series of fossil faunas on the Pacific Slope that begin to rival in interest and scientific importance the discoveries that have been made to the east of the Continental Divide. The wonderful deposit of Rancho-la-Brea, near Los Angeles, the richest fossil quarry in the world, owes its recognition to Dr. Merriam, and the admirable way in which it has been worked and studied is due largely to his wise guidance and advice. A series of Tertiary mammal faunas, extracted by persistent search from formations that at first sight appeared discouragingly barren of fossils, has enabled him to reconstruct this part of the geological succession and correlate it with the marine formations and invertebrate faunas far more satisfactorily than had been possible before; so that the California section bids fair to be the standard of reference for other regions. These are but two instances selected from a wide range of discoveries and researches during the last two decades.

Personally likeable, public-spirited, sincere and fair-minded, generous almost to a fault in his relations with his *confrères*, Dr. Merriam has been called upon more and more in recent years for organizing and administrative work. He was a leader in the organization and subsequent activities of the American Palæontological Society, and has taken an active part in the affairs of various other scientific organizations. As chairman of the Pacific Coast Committee of the American Association for the Advancement of Science at the time of the Panama-Pacific Exposition, he did much toward bringing to the attention of visitors the scenic beauties and features of scientific interest of the Pacific Slope. Since the United States entered the great war, he has been drafted for executive work, chiefly in the organization and direction of various research activities, and has been able to spare but little time for personal research in his favorite science. He now becomes president of the Carnegie Institution.

The administration of this great endowment of more than twenty million dollars under the retiring president, Dr. R. S. Woodward, has set a high standard for organized work in pure science. Great as are the resources of the institution, they might easily have been frittered away without any commensurate gain to science or humanity, through casual or unsystematic expenditure or the encouragement of the innumerable more or less visionary projects continually urged upon the trustees. The policy of the institution has been to limit its activities to a number of important problems requiring coöperative research upon a comparatively large scale, and to the support of systematic researches by individual investigators in selected subjects where coöperative research was not required. Among the larger projects the Solar Observatory at Mount Wilson, the Desert Botanical Laboratory at Tucson, the observations of the "Carnegie" on terrestrial magnetism, the Geophysical, Marine, and Nutrition laboratories are the most important. The results achieved and solid advances made in science through the work of these laboratories and individual research associates vindicate the wisdom of the past policy of the institution which will doubtless be continued in substance under its new president.

That Dr. Merriam's health and strength may be preserved for many years of scientific activity and achievement in his new position will be the prayer of his numerous friends and admirers.

LAFAYETTE NATIONAL PARK AT BAR HARBOR, MAINE

BY GEORGE B. DORR

Superintendent of Lafayette National Park

FRENCHMAN'S BAY FROM THE SUMMIT OF CHAMPLAIN MOUNTAIN

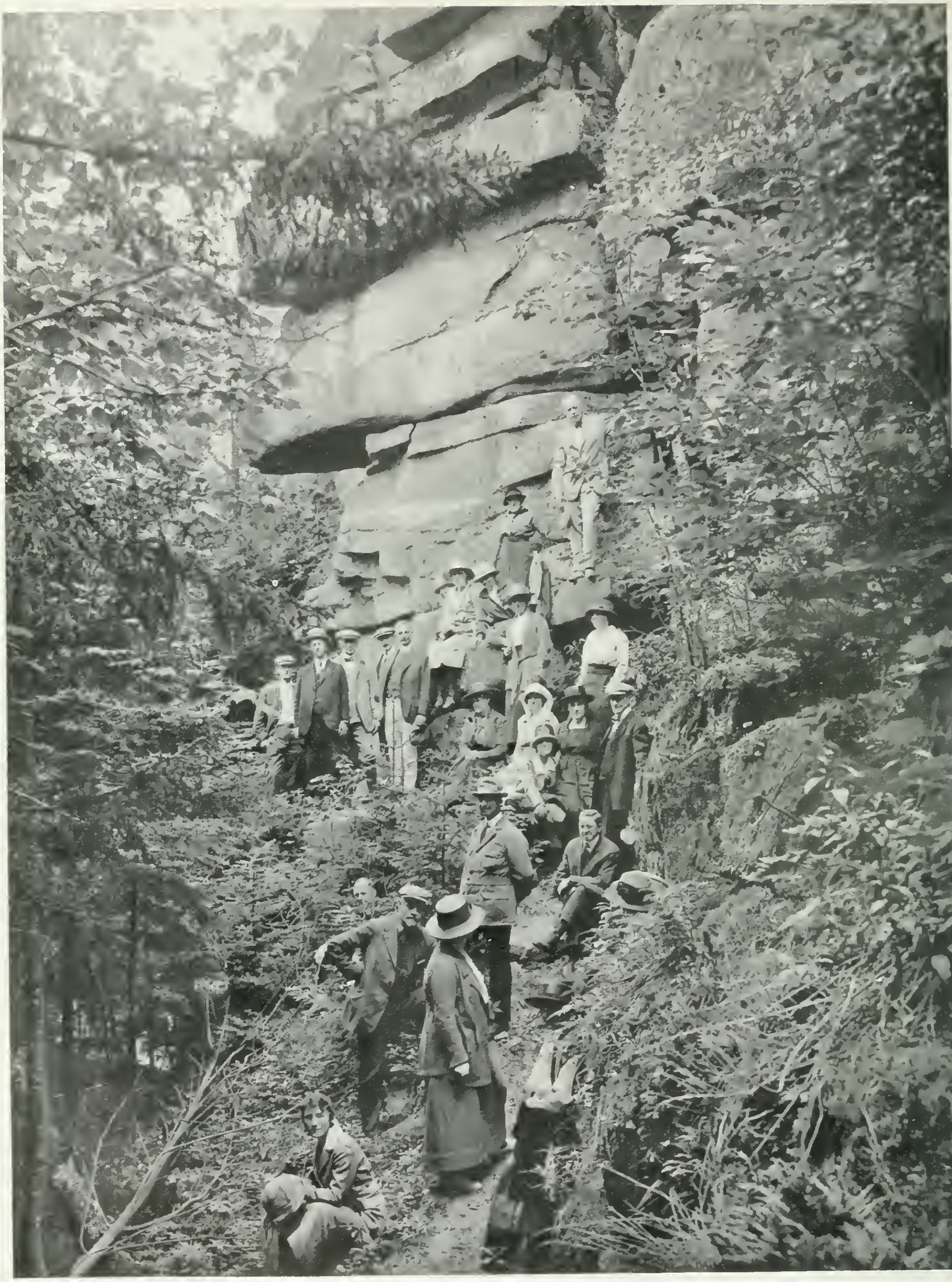
In February, 1919, the President of the United States on his return from Paris signed a bill creating the first national park, other than war memorial, to the eastward of the Mississippi—Lafayette National Park, situated on Mount Desert Island, Maine, at the crowning point of beauty on the New England coast.

Mount Desert Island was discovered in September, 1604, by Samuel de Champlain, while on a voyage of exploration for Sieur de Monts, the founder of Acadia. Champlain called it *L'Ile des Monts Deserts,* "the Island of the Wild and Lonely Mountains," from the bold peaks which rise up from its shore.

The present title to all the land not held by early "squatter's right" lying to the eastward of Somes Sound dates back to a grant from the Commonwealth of Massachusetts to the granddaughter of Antoine de la Mothe Cadillac, to whom the whole island had been originally granted in 1688 by Louis XIV; the land lying to the westward of Somes Sound was deeded similarly by the Commonwealth of Massachusetts to John Bernard, son of Sir Francis Bernard, the last provincial governor of Massachusetts save Hutchinson, to whom that province had deeded the whole island in 1762, ignoring Cadillac's earlier claim.

In recent times this island has become famous as a summer resort. In 1916 an association[1] formed for the conservation of its landscape in the public interest offered the National Government a tract of five thousand acres which President Wilson accepted and proclaimed as the Sieur de Monts National Monument. Three years later, in 1919, the status of this National Monument was changed by Act of Congress to that of a National Park—under the name of Lafayette National Park, the first in the east. In addition to the interest of its historical associations and its importance as a great resort, valuable work is contemplated in it by the National Park Service along the lines of wild life conservation. Forest typical of the Acadian region still occupies extensive portions of the park land, now doubled in area since its first acceptance by the President. Deer are already abundant in its protected woods, and beaver, which once crowded its waters, are now actively reëstablishing themselves upon them. Its position on the Atlantic Coast bird migration route gives it unique importance also, in relation to bird conservation; and the native flora needs protection only to become rich in beautiful and interesting species

[1] This association was jointly organized and promoted by Mr. Dorr, now superintendent of the park, and by Dr. Eliot, president emeritus of Harvard. (See portraits on page 264.)



THE APPALACHIAN MOUNTAIN CLUB AT THE CADILLAC CLIFFS

The Cadillac Cliffs, bordering Lafayette National Park on the ocean front, are ancient sea cliffs, cut by the stormy beating of an Arctic ocean in the Glacial period when the land stood at a lower level and Mount Desert Island was a lonely group of mountainous islets far at sea

A STAIRWAY BUILT TO ENDURE

These steps lead up the wooded side of Flying Squadron Mountain from Sieur de Monts Spring in Lafayette National Park. The frost-split granite lends itself remarkably to such construction and nature quickly takes possession of the trail, filling every crack and crevice with plants that love the acid mountain soil—blueberries and mountain cranberries, trailing arbutus, and a host besides

PITCH PINE UPON ACADIA MOUNTAIN AND THE ENTRANCE TO SOMES SOUND

Somes Sound is the single glacial fiord upon our eastern coast. It was here that the first French missionary settlement in America was made in 1613, and the wrecking of this settlement by an armed vessel from Virginia was the first act in the long struggle between France and England for the control of North America

YOUNG BALD-HEADED EAGLES IN LAFAYETTE NATIONAL PARK

This bird, *Haliaeetus leucocephalus*, the white-headed sea eagle, is our national emblem and has been taken as the emblem also of the Lafayette National Park, whose ocean-bordering cliffs and woodlands are its natural haunt. The nest, photographed in 1919 and again occupied in this year of 1920, is built high in a dead maple top

WINTER AMONG THE PINES

The beauty of the New England winter is greatest in the belt of latitude in which Mount Desert Island lies, passing through the White Mountains, the Green Mountains, and the Adirondacks. It is a belt characterized throughout by its abundant evergreens, whose winter foliage nothing in the landscape can replace

ONE OF THE MOST BEAUTIFUL NATIVE WILD FLOWERS

To be ome abundant in Lafayette National Park the fringed orchid *Habenaria fimbriata* needs protection only. The whole region is rich naturally in flowering plants, and the extraordinary concentration of favorable conditions in the park fits it uniquely to become a sanctuary for them, and a means toward their preservation

EVELYN'S MILE

This approach from Bar Harbor to the Lafayette National Park has been built in memory of a child whose name it bears. The walk runs for a part of the way through cultivated ground, dedicated for the purpose. It is planned to make this a garden entrance, naturalizing along its sides the hardy plants for which Bar Harbor gardens have been famous

IN AUTUMN

Road to Sieur de Monts Spring, its surface strewn with fallen leaves.—Lafayette National Park is unique among national parks in its wealth of hardwood trees, characteristic of the Appalachian forest, and the brilliant beauty of its autumnal foliage. In it one sees at its best and fullest the forest of the north

PLANTING A PEACE TREE IN THE PARK

A young Sequoia from California was presented by Dr. Robert Abbe, of New York, to the Lafayette National Park. President emeritus Eliot, of Harvard, Mr. George B. Dorr, of Boston, who is superintendent of the park, and a group of children are shown engaged upon the planting.

We may well contrast the mental outlook of these children in their free out-of-door life with that of the East Side New York City children pictured in Mrs. Northrop's article which follows

Nature and the City Child

By MRS. JOHN I. NORTHROP

President of the School Nature League of New York City

NATURE in the congested parts of New York City might be compared to the snakes in Ireland, "there isn't any," yet it would surely seem that every child should learn something of this world into which he has been born and where he may live his three score years and ten, should know something of woods and fields, of the birds and animals that dwell in them, and the flowers that bloom in them. How little of all this the city child really does know, few people realize.

About fifteen years ago the Board of Education put nature study into the school curriculum and drew up a comprehensive outline for the course of study, but unfortunately it made no provision for the "nature" to be studied. It *does* provide nature material for the biology courses in the high schools, but the psychological time to interest children in nature is while they are in the elementary schools, when everything in the outside world is still full of fascination for them. Nature cannot be learned from books, and as the greater number of the teachers are city born and bred and have not learned in any other way, very few are qualified to take up any kind of nature work with their children without the actual specimens before them. At one of our exhibitions, a teacher, looking at a labeled specimen, was heard to remark, "Oh, I gave a lesson on that last week. I didn't know it looked like that!"

So the children learn the words but not what they stand for. They can repeat poems about roses and buttercups and ferns, but they do not recognize them when they see them; they will call everything "roses or violets," and ferns often suggest only "soup greens." An ordinary brown bear caterpillar was once shown to a number of classes. The children ventured opinions that it might be a frog, a turtle, a snake, or a worm, but when told it was a caterpillar, with one accord they glibly informed us that "it turns into a chrysalis and then into a butterfly."

The American Museum of Natural History, through its department of public education, has accomplished much good by means of talks and pictures and the traveling cases of specimens it lends to the schools. It is a long step in the right direction, but it is not enough to bridge the gap between city and country. In many sections of the city the child, and also sometimes the teacher, can supply no background whatever; the bird or insect or shell is only a thing in a box, he cannot imagine it in the woods, among the budding trees, flying over flowery fields, or on a sandy beach, because he has never seen these things.

Realizing the futility of much of the so-called nature work, the educational authorities are, it is said, considering dropping the subject in the most congested districts and retaining it only in the suburban schools where material for study is readily available. Some of us who have been interested for many years in the teaching of nature in the schools feel very strongly that the thousands of children who are condemned to a brick and mortar environment are the very ones who need "nature" most, and who would most appreciate a glimpse into another and more beautiful world.

The School Nature League, which was organized in 1917 "to increase a knowledge and appreciation of nature in the children of our public schools," decided to see if something could not be

MRS. JOHN I. NORTHROP

President of the School Nature League, New York City

If we cannot take the children of New York City to the country, we must bring all the country that is transportable to the children. It seems only fair that the many thousands of children confined to an environment of brick and mortar should know something of the living world into which they have been born and where they are to spend their three score years and ten. And how could it be anything but misfortune that they should have no share in the joy that comes from knowledge of the woods and fields spread out in sunshine with their trees and birds and flowers?

Moreover, one of the great needs of America is a larger number of men and women who like the country well enough to be drawn to enter agricultural life. Here in the heart of New York, a world of high stone walls and narrow stone pavements, incredibly congested with human beings, the School Nature League is creating among the children, through the stress of their very lack, a profound longing for the wide out of doors. Why should not the nature rooms in the schools prove laboratories which will instill, at just the years when children are most easily influenced, an interest so deep that some at least will ultimately be led into such work as scientific farming? The experiment is surely worth making

Courtesy of Underwood and Underwood

OH, HOW I WISH I COULD SEE THESE THINGS GROWING!

Members of a class of crippled children in their nature corner at Public School No. 75

These rather serious-minded little people delight in wandering slowly about their woods corner, back and forth wherever they wish, examining objects that interest them—the budded twigs from trees in "the country," the shell that whispers into their ears the roar of the sea. It is in large part the voluntary and individual character of the observation that makes the strong appeal and impresses their minds indelibly

Courtesy of Underwood and Underwood

A seabeach—at first so unfamiliar.—Sand is always fascinating, even if there is only a little—just enough to pour back and forth through the hand (see child at the right in the picture opposite). An isolated shell, or a starfish, or fragment of coral is an object of curiosity. But relate all these, spread them out on a table, and the interest is enhanced a hundred-fold. The imagination sees a miniature seabeach. The shell is no longer dead and empty but animated by the animal that always moved within its shelter. Especially is the sense of life imparted in the minds of the children to everything on the miniature beach by the presence of the aquarium. Delicate green plants sway here and there as the goldfishes, polliwogs, or newts swim past. And the correlation is particularly strong in the instances where the nature room is light enough to allow the establishment of a salt-water aquarium with green sea lettuce, with sea anemones, sea snails, and tiny fish. During 1919 nearly six hundred teachers, representing twenty-six different schools, were supplied with material for leisurely "follow up" observation in the classroom, correlated with the relatively occasional nature room visits

done to bring nature and the city child together. It could not take the children to the country, so went at the problem from the other end and tried to bring all the country that was transportable to the children.

Through the kindness of the Board of Education we were allowed the use of vacant rooms in some of the schools for our experiment. Some of the rooms were dark and dingy and some very tiny, but we did our best to transform them into real "nature rooms," making them as "woodsy" as possible with leafy branches, winter bouquets of fruits and seeds, and when there was sufficient space, with one or more cedar trees in which mounted birds and squirrels (loaned by the Museum) disported themselves near their nests. Every room has a green expanse of moss and lichen dotted with ferns and here and there a bit of partridge berry or wintergreen, which we tell the children is what the floor of the woods looks like. Rather surprisingly, this is one of the favorite exhibits, and children never tire of feeling the moss, "so nice and soft."

In another corner is a miniature

Courtesy of Underwood and Underwood

THE SEASHORE MUST BE A VERY WONDERFUL PLACE beach—stretches of sand strewn with pebbles and shells, corals and starfishes. In the rooms that are sufficiently light the beach has in its midst a "sea garden"—a salt water aquarium with sea anemones, sea snails, sea lettuce, and tiny fish. In the other rooms are fresh water aquaria with the always fascinating goldfish, "polliwogs," newts, and turtles, and in one or two of the rooms are terraria with garter snakes and a few frogs or small lizards as inhabitants. Even when the animals move, the children always ask, "Are they real?"

Among these permanent exhibits are tables for seasonable nature material, that these city children may be kept in touch with the changing year, even though their daily surroundings are grimy brick and mortar. For example, spring comes to the nature rooms in the shape of budding twigs, germinating seeds, sprouting acorns, and early flowers, and on the animal side, in fascinating frog and toad spawn that may hatch before one's very eyes, or cocoons and chrysalises that may disclose their wonderful secrets at any time. Common wild and garden flowers, from the skunk cabbage and crocus to the daisies and roses, keep the flower tables in the nature rooms bright from April until late in June, when the rooms close.

They are opened again in October, gay with autumn foliage and the wild and garden flowers of fall, together with fruits and seeds of many kinds, the latter arranged to show their method of dispersal. December brings holly, evergreens, and cones to the rooms, while we utilize the tables in January for exhibits of bird and insect homes and their builders, arranging the nests in leafy branches or in their appropriate habitat, with the mounted bird near by (the latter loaned by the Museum); also nests of mud and paper wasps, and perhaps a trapdoor spider's fascinating nest in a box of sand; or we may show types of birds and animals, or collections of woods, or of common minerals. Some of these collections are moved about from room to room. In February we bring in the budding twigs, which to the children's endless delight often leaf out and blossom, and we also start seeds germinating, while March ushers in the spring again.

To step out of the dirty, squalid street into these woodsy retreats is a constant surprise to the children. One little visitor asked wonderingly, "Is this a school?" and another said, "This isn't a school, this is a woods," and the little kindergarten children always call a visit to the nature room "going to the country." Even to the adults it is a veritable oasis in a wilderness of bricks. One mother said it was the first bit of outdoors she had seen since she had left the country of her own childhood many years before.

The School Nature League now has seven nature rooms in as many different schools, the exhibits naturally varying somewhat according to the size and the amount of light. Several principals who were anxious to have nature rooms could not spare an entire room, so in the Crippled Children's School we utilize one end of a large work room; in the School for the Deaf the large platform in the assembly hall was the only available space, while in a third we have converted the equivalent of a tiny hall bedroom into a "woods room" and its twin into a "bird room." It is really surprising how much pleasure and profit and how much real feeling for nature the children get even in these cramped quarters. If good work can be done under these conditions, there are surely very few schools that cannot make some provision for nature study.

All of the nature rooms are visited during school hours by classes with their teachers, usually for half-hour periods, and regular lessons on some special material are often given. Specimens are always clearly labeled. Some of the larger rooms are "neighborhood nature rooms," and a certain amount of time each term is allotted to schools within walking distance. Last year the five nature rooms then in operation were visited by more than 25,000 children representing nineteen different schools. As many classes came a number of times, the 25,000 represent visits rather than different children. Superintendents, principals, and teachers all bear testimony to the value of the nature rooms in imparting the breath of life to what was formerly the dry bones of nature work. The teachers are grateful for the help, and tell us their classes often talk of the visits to the nature room for weeks afterward.

One of the most interesting experiments in the work has been throwing open the room at 25 Norfolk Street to the children who wanted to come in after school. At first we kept it open only one day in the week, but soon found we could not accommodate all our would-be visitors. When one girl wrote us, "I wish that the nature room would give us more visits a week than she does," we felt impelled to open it twice a week, and many of the children tell us they would like to come every day.

If anyone doubts whether the children of the East Side love birds and flowers let him come to Public School No. 62 any Tuesday or Thursday afternoon from three to four-thirty o'clock. The moment the door is open the youngsters crowd in, from toddlers of three and four, escorted by an older sister or brother, to boys and girls of the junior high schools, who ask to see all sorts of things they have read about. A number come regularly and act as guides to their friends, proudly pointing out the terrarium where the snake lives, the shark's jaw with its generous supply of teeth, hanging by the window, the stuffed squirrel and his nest in the cedar tree, or showing how the puffballs on the moss table "puff." The room is evidently a fairyland to them, and we have hard work to get them out at closing time. They walk about from table to table, some of them taking notes, and their delight is unbounded when they find something they have before known only in books. The regular visitors look about for new arrivals on the tables and several of them say that they come every week, and that they know everything that is in the room.

A group will stand spellbound with shining eyes and parted lips while we talk to them about the different kinds of nests, point out the front door of the woodpecker's hole and the chisel-like bill with which he made it, or let them inspect the wonderful weaving of the oriole's cradle, or tell them how the chimney swift makes its curious nest, or the marvel of the humming bird's tiny home. They are just as much interested in the shells and starfish and corals on the beach or the spore plants on the moss table, in the "dust" in the puffballs and earthstars, and where the spores are to be found in the ferns and mosses and club mosses. After a talk of this kind one child wrote, "I thank you for staying in that afternoon and teaching us a wonderful lesson about flowerless plants. Puffballs I think are the most curious plants I saw. I love to see them have their spores out of a little hole." Another wrote, "I go to the nature room every week, I like it better than the movies," while a third said, "I went down to the nature room and I saw everything. I saw all kinds of flowers and I saw all kinds of plants. I saw all kinds of fishes and starfish and I saw frogs' eggs."

That the interest of the children is more than a transient curiosity is proved by the report of the librarians of the neighboring Seward Park Library, who said they could not understand the unprecedented demand for nature books until they saw the nature room. The children are also so full of the wonders of the room that in many cases they importune their teachers

Courtesy of Underwood and Underwood

FUTURE CITIZENS OF AMERICA

Visiting an exhibition of birds and their nests in the nature room at Public School No. 62, New York City

The years of early youth are the impressionable years, when in the child's mind is laid a foundation on which the superstructure of manhood or womanhood will rest. There can be some approach in the future toward making the American nation what we wish through education of the children. Our schools need men and women of strongest character, not merely of keen mind, who through direct personal contact for many hours each day and frequent personal expression will imprint their high ideals upon the children of America

Courtesy of Paul and Company, New York

AT A FALL FLOWER SHOW OF THE SCHOOL NATURE LEAGUE

Public School No. 15, Manhattan

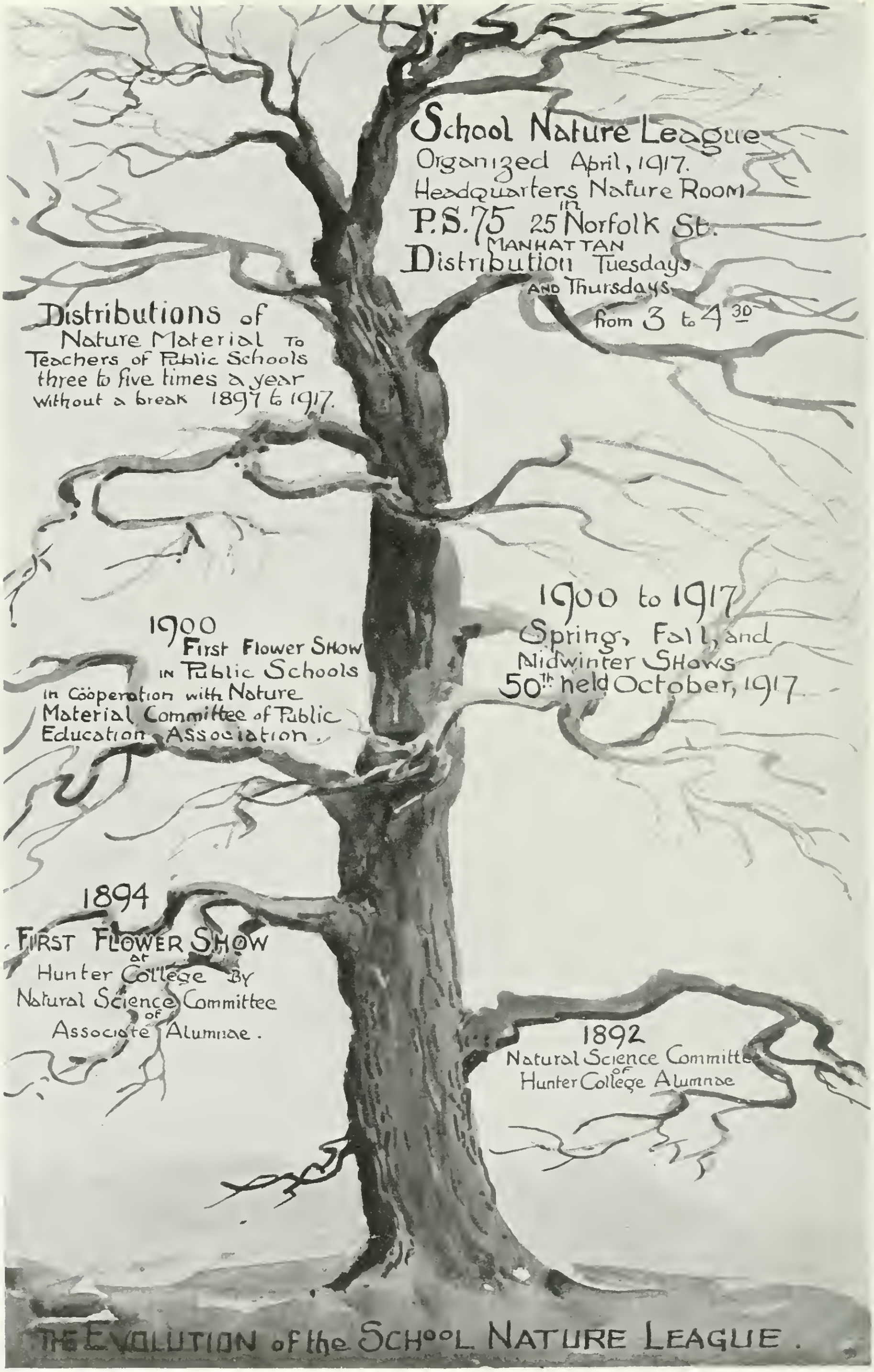
The "flower show" is now a regular part of the work of the School Nature League of New York City, under Mrs. John I. Northrop. Ever since 1900 there have been held three shows each year, in spring, fall, and midwinter, respectively. The fiftieth exhibition occurred in October, 1917. In 1919 about 10,000 children visited the flower shows.

The shows are held in different schools different years, and as often as possible in schools which have not yet an established nature room. There may be more than two hundred different kinds of plants exhibited. The wild flowers and the garden flowers are arranged separately, each distinctly labeled with its common name.

Something of the contrast between the usual life of the children and these four to ten days of the beauty and fragrance of flowers and tree branches may be understood from the following statistics: "In New York East Side schools of a thousand pupils it is sometimes true that more than 75 per cent have never seen the country, and more than 50 per cent have never seen even Central Park of New York City. There are schools on the East Side where not even one member has ever seen grass growing."

Source of material is the great and ever troublesome problem of the School Nature League. At present although it has the coöperation of various institutions and individuals, the greater part of the supply of flowers for any particular exhibition, or for the steady upkeep of the nature rooms, is obtained by the League members themselves or by their friends. Innumerable long-distance automobile trips are made to country spots in New York or adjoining states where flower growth is abundant or where some highway or other "development" has decreed that all the wild flowers and other plant growths of the area shall die.

It would be fortunate for the schools if there could be a definite and formal agreement of coöperation with the city parks by which they would grow for the schools as a part of their regular work certain flower "crops"—a contribution to the higher development of the city's children. For, on the curriculum in the lower grades, nature work stands almost alone as a subject with strong appeal to the spiritual side of the child



The work of the School Nature League has been developed under the direct leadership and supervision—without remuneration—of Mrs. John I. Northrop, whose portrait is presented on page 266. Mrs. Northrop started this work in 1892, with Hunter College graduates who had been in her classes as helpers. She has given herself to the needs of the children of the East Side for more than twenty years—with energy and good cheer, with large knowledge of nature, and sympathy of understanding for pupils and teachers.—THE EDITOR.

until they come to visit the room with them.

The League also has had nature poems printed, entire poems or extracts from Emerson, Tennyson, Lowell, van Dyke, and others, which are given to the children or their teachers at the appropriate season, or when the subjects written about are on exhibition. The children often learn these poems of their own accord. One little girl wrote, "I have been but once to the nature room, but you can't guess how I enjoyed it. I was very glad we had the poem on trees (Joyce Kilmer's) because in the nature room I saw cedar trees and branches of trees."

Realizing that the occasional visits to the nature room, which are all that is possible in most cases, are not enough, the League provides for "follow up work" in the class rooms by supplying the teachers with specimens which the children can watch and study at leisure. Even if the teacher can find little time for regular lessons, the developing twig, sprouting seed, or growing tadpole teaches its own fascinating story. The children who come to the nature rooms regularly are intensely interested in having a "nature room in our class room," and they tell us proudly of the new leaves on their horse-chestnut twig or flowers on their cherry branch, or that their tadpole is "getting hind legs," while others whose teachers have no interest in nature come in dejectedly and beg us to "get our teacher to come to the nature rooms and get twigs and mosses and nests and things." In these cases we give the children some specimens and advise them to look about carefully and then tell their teacher about all the different things they can find and how much they enjoy them, and to invite her to the room until she comes, and usually she does come and is promptly converted. If after a lesson in the rooms, we ask the children if they would like to have some of the things to take back to their classrooms, their eagerness and delight are really pathetic, and off they go bearing their treasured twigs or nests or flowers as proudly as if these were a king's ransom.

Two of the nature rooms are kept open on certain afternoons every week from three until half-past four to give teachers an opportunity to come for nature material. During 1919 we supplied 576 teachers representing 26 different schools with such things as fruits and seeds, autumn foliage, winter bouquets, birch bark (taken from "down timber" only), mosses, lichens, fungi, evergreens, cones, frog spawn, birds' and wasps' nests, shells. When teachers are sufficiently interested to become members of the League (by the payment of fifty cents a year) we also give them Audubon leaflets, as well as others we have ourselves published on buds, fruits, seeds, and on lower plants. We label their specimens, tell them how to care for the material, and help in every way we can. Those who come are always most grateful and appreciative, for, unless a teacher lives out of town, it is well-nigh impossible for her to get material for her lessons, much as she knows it is needed, and much as she would like to have it.

In addition to maintaining the nature rooms and distributing specimens to the teachers for their classrooms, the League works from still another angle by means of spring, fall, and midwinter "shows" which it holds every year, each time in a different school, and usually where there are no facilities for a permanent nature room. These exhibitions are frequently arranged in some part of the playground. The spring and fall shows continue for three or four days, the midwinter one of evergreens, nests, shells, mosses, fungi, etc., for ten or more days. During 1919 more than 10,000 children representing 16 different schools visited the shows and had at least a glimpse of a new and wonderful world. As in the nature rooms, all specimens are plainly labeled, and they are grouped under such headings as "wild flowers," "garden flowers," "flowers that make fruits good to eat," "mosses and ferns and their relatives," etc. Usually the first exclamation is "How good it smells!" and little noses are buried in the blossoms for a more satisfying sniff. The children look at us so wistfully when we tell them about the woods and fields in which we gathered the specimens, and which many of them have never seen. After a visit to one of the shows one boy wrote that he just wished he could live in the country and see these things every day. The Spring Show which has just been held was the fifty-eighth exhibition. When the show was broken up and everything that had survived the three days' exhibition was sent to the classrooms, one little girl said her room looked so pretty that she didn't want to go home.

It is evident that a vast amount of material is continually needed for the nature rooms, the flower shows, and for distribution. This is provided by the officers and members of the League and their friends, by children of country and suburban schools, Scout Troops, chapters of the National Plant, Flower, and Fruit Guild, the city parks, Botanical Garden, etc. The American Museum has been our most constant and loyal supporter, and we have met with coöperation on every side, from superintendents and principals and from the libraries, the Aquarium, and park officials. A number of camps also made fine collections for us during the summer. Why should not the city parks grow specimens for the schools in quantity as a regular part of their work and the museums turn over to the schools any imperfect or unusable material? To provide the nature is a large problem, but the results are surely worth working for.

After three years' experiment with our nature rooms we feel that they really can solve the problem by which, even in the heart of a great city, nature can be made to mean something to the city child and become a real part of his life. Moreover, we have proved that he eagerly welcomes this kind of knowledge and that it brings him something no other subject can. As one principal put it, "I consider nature study, taught in this way, one of the most valuable in the whole curriculum because it, almost alone, touches the spiritual side of the child."

What we have done is just a beginning; there should be a nature room in every school. There is nearly always one nature enthusiast among the teachers who would take charge of it—and there should be a competent director of nature study appointed just as there is now a director of sewing, drawing, music, or cooking. Why cannot this great city which is looking after the child's physical well-being, his eyes, his teeth, his lunches, also remember that "man does not live by bread alone," that these children long to see and learn about the beautiful things of wood and field, that they too would gladly sit at the feet of Mother Nature and learn some of her secrets. Do we not owe them at least a peep into nature's fairyland before they are engulfed by the great city, and become too sophisticated to want it?

Moreover, there is a very practical side to this work. One of the crying needs of the times is "more people on the farms." Why neglect the opportunity then to interest the children in the wonderful and beautiful things of nature when they are at the most impressionable age, so that they will be glad to live in the country when they grow up? One boy who often visited the nature room confided to his teacher that when he grew up he wanted to be a scientist and live in the country where he could see and learn all about these things. Why should not the nature rooms prove laboratories for the making of scientific farmers? Is not the experiment worth trying?

The Manufacture of Pulp and Paper as an American Industry

By HUGH P. BAKER

Secretary-Treasurer, American Paper and Pulp Association, New York City; formerly Dean of the New York State College of Forestry, Syracuse University

THE manufacture of paper as a human activity ranks in age second only to the manufacture of textiles.

Not, however, until the printing press in a crude form came into use, and books were made, did there arise any demand—any need—for the making of paper so that it might be used commonly. It is rather peculiar, possibly, that even with methods of paper manufacture known for thousands of years, it is a matter of only a few hundred years that the paper mill has been known. In this country three or four human generations indicate the age of the manufacture of paper as an industry.

Not until the development of the modern newspaper and the perfection of methods in the production of cheap editions of books, did there come the demand for paper that has made its manufacture a great industry. Today we hear more of the demand for news print paper than for any other. There has been exceedingly rapid increase in its production, yet production has not kept pace with consumption. In 1899 the consumption of news print paper alone in the United States amounted to 569,212 tons; in 1918 the consumption was 1,760,517 tons, an increase of approximately 200 per cent. The per capita consumption of news print paper increased from three pounds in 1880 to thirty-three pounds in 1919.

Present Development of the Paper Industry

The paper industry is relatively undeveloped, and has tremendous possibilities in the ever increasing demand for paper of all kinds—a demand due both to increasing population and to increasing use of paper. The rapid development, in the last five years, of the use of the paper carton or box in the shipment of all sorts of materials is indicative of the way in which we may expect the industry to grow with the coming years.

The manufacture of news print paper depends largely upon an available supply of wood of the right character, and yet but from 7 to 8 per cent of the total of the wood produced annually from the forests of the country goes into the manufacture of paper. The production of paper, then, is not largely responsible for the disappearance of our forests.

The last few years have seen the development of larger and more efficient paper mills, but we have not yet reached in the development of the paper manufacturing plant the high point attained in a similar direction in the lumber industry. The well-equipped paper mill involves great initial expense. For instance, the paper mill producing news print paper in an effective way may cost a million and more dollars, and it is not a simple thing to move this plant with the disappearance of the forests, or with the increase to the prohibitive point of the cost of transportation of wood. The result is that there is no industry more dependent than this upon the permanency of our forests, or upon the renewal of forests on lands which have been denuded.

The Paper Industry and the Forests

The possibilities of development in the industry in the way of manufacture of news print, fiber, and box board, wrapping papers, and the like, are such that a constant supply of wood from the forest in the future is necessary. The woods most commonly used have been spruce, fir, hemlock, the cottonwoods or poplar, and some of the hard woods. Light-colored, nonresinous, long-fiber woods that can be produced with comparative ease, and that require little or no bleaching, are best adapted for ground wood pulp. These requirements are met most effectively by the various spruces grown in this country. More than 84 per cent of the total pulp manufactured in 1918 was made from four species of woods in amounts as follows: spruce 55 per cent, hemlock 16 per cent, balsam 7 per cent, and poplar 6 per cent. Some of the pines and various hard woods, such as beech, birch, and maple, have been used by the mills in this country for a considerable time. It is probable that much more hard wood will be used in the near future than has been used in the past, not because the hard wood is especially adapted to the manufacture of paper, but because it is available where the supplies of soft woods such as the spruce and fir, are rapidly disappearing.

The solution of the problem of future supply of woods for the paper mills of this country lies in the more sensible use of the virgin forests which still exist, and aggressive reforestation and development of forest lands not now producing forests. There is enough potential forest land in the states east of the Mississippi to produce forests of soft woods that would not only give an annual crop large enough to take care of the manufacture of the paper needed in the United States, but would also make the United States a great export nation of paper—as well as of other products of the forests.

The American Paper and Pulp Association has put itself on record in such reforestation work through its Committee on Forest Conservation. It must do more than put itself on record. It must carry on a campaign of education that will not only interest other industries dependent upon the forests, but will also show the people of the United States that it is to their advantage to make permanent paper manufacturing, lumbering, and all other industries dependent upon wood by attention to the permanency of the forests; it must get back of a movement that will reforest not a few thousands of acres a year, but millions of acres.

Solving the Problem of More Paper

There is one word that can be used to indicate the solution of the problem involved in producing more paper in America, and that is—education. Education within and without the industry is fundamental to keeping it in its present place or pushing it still farther forward among the great industries of the country.

The future of paper manufacturing and of other industries dependent upon the natural resources of the country rests very largely upon the effective education of the general public as to the needs and the aims of the industry. Let the public know something of the problems involved in the manufacture of paper. Let it know more and more of the importance of paper in daily life. See that the people realize that the industry is interested in the conservation of natural resources, that the welfare of the entire public depends not only upon vast natural resources, but upon the efficient use of these in the upbuilding of industry and trade. Is there any department of the government, any educational institution, any group of people anywhere in the country more interested in the permanency of supply for an industry than the industry itself? Why should the paper industry, dependent upon the forests and upon other raw materials, depend upon the federal government or upon educational institutions to conserve natural resources that make for the permanency of the industry! Beyond a question it will be money well invested if the industries will carry on militant coöperation and aggressive coordination of effort, making for the conservation and efficient use of the natural resources of America.

Organizing for the Production of Paper

The paper industry has felt itself to be efficiently organized for production and yet there seems to be room for improvement. There is more in organizing for production than merely increasing the output of a particular machine or of a particular mill. There have been mills which organized for production and increased their output by increasing efficiency within the mill, without paying any attention to the permanent supply of raw materials which would keep the machines running at highest efficiency, or without considering the marketing of the products in such a way as would make the increased efficiency in the mill worth while.

Organizing for production today goes away beyond merely increasing the productiveness of a single machine or of the mill. There should be organization to make permanent the supplies of raw materials of all kinds, not alone that we may have more wood, or more rags, or more jute, but that we may produce our own dyes, our own clay, our own alum. The American Paper and Pulp Association has taken a very definite stand for conservation, but it should go further than the mere printing of a program. It should have a "woodlands division" made up of representatives of every mill owning woodlands. It should have a committee dealing with the problems of raw materials other than wood, and with the problems of standardization within the industry.

After forty years of an American Paper and Pulp Association the industry waited until 1919 for the formation of a Salesmen's Association. This association should be strengthened because it is vitally important that the products of the mills be placed upon the market as efficiently as they are manufactured. There are untold possibilities in the way of uniting various spasmodic and separate efforts to educate the public as to the use of paper products. What has it meant to the industry to educate the people to use paperboard boxes as containers? What tremendous development there has been in using wax paper on food products! Is anyone willing to say that we have gone as far as we can in extending the use of paper? How much more effective would be organized effort than the expensive individual effort that occurs here and there through the country at the present time.

There are certain laws underlying the development of any industry. The officers of the American Paper and Pulp Association will come and go, but the principles of the development of the organization will remain the same. As there is truth in the patriotic statement, "In union there is strength," for the state or the nation, strength in the development of an industry also will result from unified effort. Effort there will be on the part of every manufacturer of paper; unified effort will be more difficult, and yet it comes, and will come, and as the result of it we shall not only make the paper industry take its place aggressively with the other great industries of the country, but, because of what we can and will accomplish in the struggle for the conservation of our natural resources, the industry will also be a vital factor in the welfare of the American people.

The Wood-pulp Shortage

CURTAILMENT OF PRINTING AN INEVITABLE RESULT

By WILLARD G. VAN NAME

Department of Invertebrate Zoölogy, American Museum of Natural History

THE shortage of material for paper making and the apparent absence of any commercially practicable source for paper pulp except the wood of our rapidly disappearing forests is one of the problems of the present time.

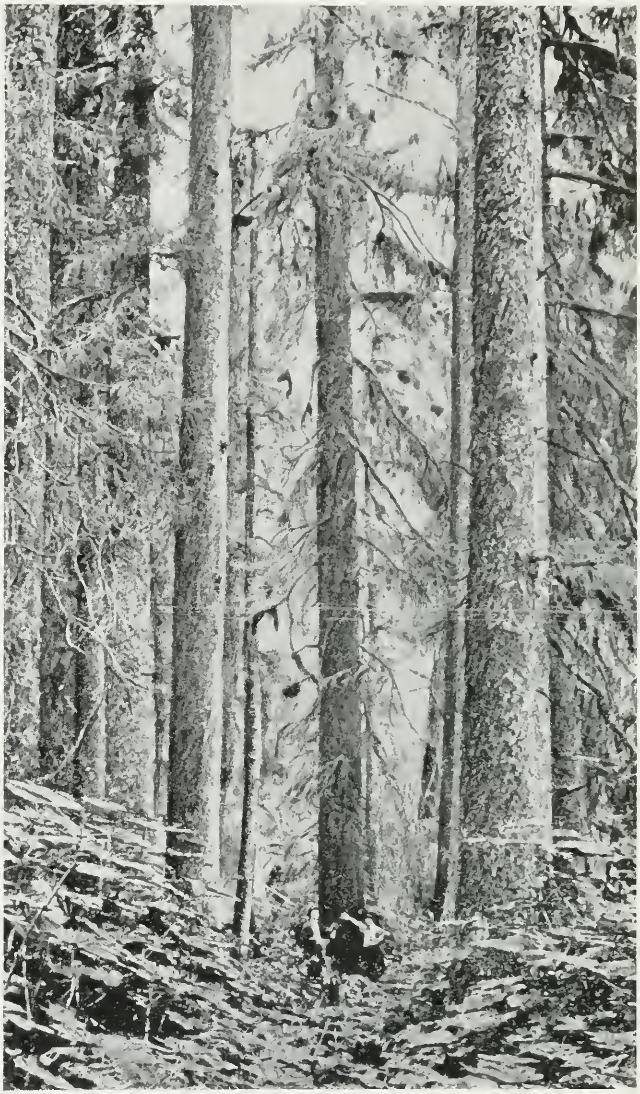
From the commercial and industrial aspect, it is only necessary to look ahead two or three decades at most; the lumberman and the paper maker are in business for one purpose only, to earn money, and money to be obtained now or five years from now, is of vastly more importance to them than a serious crisis in the industry twenty-five or thirty years from the present when others will have to meet the losses and difficulties. Even the chief consumers of paper if forced to choose either cheap wood pulp for the next ten or fifteen years, followed by a paralyzing scarcity at the end of that period, or an *immediate restriction of production* in order to insure a permanence of the supply, would probably choose the former alternative. From their point of view, that of making money, they might be right. Yet this would not be the best solution for the public in general. The nation and in fact the whole civilized world is vitally interested in maintaining a sufficient supply of paper for its present necessities and future progress, and if our extravagant use of wood pulp is consuming the principal of the supply and not merely the interest (which is limited to the annual reproduction under the best practicable forestry methods), a crisis, not only in the paper industry but in every activity dependent on the extensive use of paper cannot be indefinitely postponed.

Scientific forestry and artificial reforestation may solve the lumber problem of the future to an extent that will enable us to get along, but they never can more than somewhat moderate the inevitable shortage of pulp wood. The reason is that for the latter purpose very small and young trees can be and are used, resulting in completely stripping the ground. There can be very little selective and scientifically conducted cutting, especially now, when the high price of labor makes it very costly to go over the same ground more than once.

One of the chief reasons for the poor success of many forestry operations in this country has been that the most essential factor in the growth of trees is neglected both in theory and in practice. It is not trees alone that constitute a forest: the soil from which the trees grow is even more important; if the latter is kept in proper condition and sufficient in quantity, the tree growth is rapidly reproduced. But by such stripping of the land as the pulp-wood industry causes, there is exposed to the sun, wind, and rains the soft spongy covering of the ground—vegetable mold and decaying leaves and branches with comparatively little mineral matter, a mixture that is the most essential factor in maintaining and restoring forest trees. When this is baked and hardened by the sun, or reduced to dust and blown or washed away by the winds and storms, the growth comes almost to a standstill, and real progress toward reforestation is impossible until, after a long period, proper soil conditions have again gradually developed. There are no forestry methods other than such as involve prohibitive expense that can avoid this disastrous result of the wood-pulp industry, and it follows from this that reforestation will be very slow, and still slower after each and every subsequent cutting.

Another serious economic aspect of the subject is the use for wood pulp (in the northwestern states particularly) of much fine large timber that within a few years will be very badly needed for lumber. Present industrial conditions render this financially profitable, but the serious economic mistake of using trees that it has taken several centuries to produce, for purposes for which young growth of a few years of age could be employed, needs no demonstration. We shall pay dearly for it.

There appears to be no way of avoiding the conclusion that the shortage of wood pulp and the era of expensive paper have come to stay; if the opening up of new sources of supply relieves prices at all, it will be only a very brief and temporary respite. There is no alternative to the necessity of cutting down our present extravagant use of the product. The sooner we begin the less we shall suffer later on.



Courtesy of "American Forestry"

Pure stand of Alaska spruce in the Tongass National Forest, recommended for grinding into paper pulp. In the past, lack of foresight has allowed devastation of American forests of many hundred years' growth for pulp wood which requires only small trees and second growths or even the waste from lumbering. Shall we now allow pressure of economic conditions force a continuation of such sacrifice? Will not curtailment of printing, for instance of *display advertising*, for a period of years, by means of a graduated tax, save many thousands of acres of forest with no detriment to industry? Meanwhile, young forests on denuded or waste land, particularly in the neighborhood of large paper mills, can be pushed to produce an adequate supply of pulp wood

How is the use of paper to be cut down with the least inconvenience to the public and least interference with business and educational progress? Can it be made anywhere with greater saving and less loss to the nation than by suppressing the present destructively competitive advertising that almost eats up the profits of many branches of industry and is responsible for expanding our magazines and newspapers to a size that makes them an inconvenience to their readers, a tax on our overburdened transportation facilities, and an enormous waste of wood pulp?

Advertising is a necessity for modern business. Even advertising to create a demand, not merely to assist in supplying it, is legitimate and must be provided for. But much of the advertising that is done today has no such purpose. Is a single additional automobile tire sold because of the many acres of forest that are sacrificed each month to provide full-page advertisements in the magazines and Sunday or daily papers, or in printing the reading matter that is used to "float" this excessive advertising? The only result is to divert trade from one manufacturer to another. The public and the nation will pay and are in fact already paying for the cost of these needlessly expensive and wasteful display advertisements which are necessary only because some other manufacturer or dealer has them.

Were this extravagant form of competition to be kept within bounds by a federal tax on all printed advertisements above a certain size, the volume of trade would hardly be appreciably affected, since smaller advertisements would then be as effective as the large and ever-growing ones are now. A tax on advertising is no new proposition but has been employed in many countries. In Italy, for instance, before the war, and probably still, a revenue stamp was required on many forms of advertisements, even those placed inside a store window so as to be seen from the street. Small notices serving as a medium between the manufacturer, dealer, and purchaser are not merely a convenience but a necessity to all parties; they should, of course, not be taxed at all, for the tax should be levied primarily as a conservation measure, not for revenue, or for the latter only secondarily; but the large display advertisements for which the public has to pay the increased prices, and which is one of the main causes of the present paper shortage, could be greatly reduced by a graduated tax increasing rapidly with the size of the advertisement.

Yet today we are doing exactly the opposite. The government is not restricting but is encouraging extravagant advertising. The public is being heavily taxed to provide cheap mailing rates for advertising matter (many of our magazines and newspapers are little else), and our railroads, unequal to the transportation of necessities, have this additional and unprofitable burden placed upon them.

Any restriction of advertising will probably be bitterly opposed by nearly every magazine and newspaper in the country, since for many it has been the source of their chief or only profit, and will probably also be opposed by most advertisers; but with the evident impossibility of continuing the output of printed matter on the present scale, it is possible that the subject may soon be regarded in a different light.

A curtailment in the use of paper and other wood-pulp products is unavoidable. If it is not made by intelligent regulation of the less important uses of the material, the educational and scientific progress of the nation is certain to suffer from the prohibitive prices which will soon prevail.

Façade of the new hall of the College of Physicians of Philadelphia[1]

The Library of the College of Physicians of Philadelphia

By W. W. KEEN, M.D., LL.D.

A former President of the College[2]

THE "College of Physicians of Philadelphia"—the legal name of the institution—is not a teaching college. It has no faculty. Its members are "Fellows." It has no power to grant degrees. The term "College" is used in the old Roman sense, that is, a collection or society of colleagues. One sees the medical use of the word in the "Royal College of Physicians" and the "Royal College of Surgeons" in London, Edinburgh, and Dublin, and its similar ecclesiastical use in the "College of Cardinals" assembled for the election of a new Pope.

At its monthly meetings, scientific communications are read and from time to time special scientific lectures are delivered by distinguished medical men of this and other countries.

The college was founded January 2, 1787, by Drs. Benjamin Rush, William Shippen, Jr., John Redman, John Morgan, and nine others. It is therefore the oldest medical organization in the United States, except the New Jersey State Medical Society: of its kind it is by far the oldest one in this country.

This brief sketch concerns its Library. We must pass by for the present its other public services in active coöperation with similar bodies and with public officials, its scientific investigations as to public hygiene and the health of the community, the important scientific papers read before it and published in its many volumes of *Transactions*, and its services to the community through its free Directory for Nurses.

[1] For a full story of the origin and development of the College of Physicians see the pamphlet "An Account of the College of Physicians of Philadelphia." By G. E. De Schweinitz, President of the College, 1912. J. B. Lippincott Company, Philadelphia.

[2] Dr. Keen is President of the International Congress of Surgery, meeting in Paris, July, 1920.

At present the Library consists of 125,000 books, 112,000 as yet unbound pamphlets, besides many exceedingly rare books of which more anon. It is growing at the rate of more than 3000 volumes annually. Except the Library of the Surgeon General of the Army in Washington, the largest in the world, it is the largest and most important medical library in the United States. It ranks about fourth or fifth in size in the world.

No other medical society in Europe or America has so beautiful, commodius, and stately a home as the College of Physicians of Philadelphia. The present building is 108 feet front by 150 feet deep on a lot 130 feet by 180. It is surrounded on three sides by streets and by a beautiful garden on the fourth side, thus giving us light, air, and protection from fire. The building itself is fireproof. It was dedicated in November, 1909.

The Library had a very modest beginning in June, 1788, when Dr. John Morgan gave to the college *twenty-four books*. Its early Fellows were good Grecians and Romans—as became graduates of Edinburgh and Leyden, as many of them were—and through them and by later gifts and purchase, our Library is rich in the early classics of medicine in Latin and Greek.

The Library provides first of all for the needs of the *working doctor*. Hence it keeps up with the advances of medicine and surgery by large monthly additions to the Library and by taking (before the war) 1200 medical periodicals. The war made sad ravages among these periodicals but we are beginning to recuperate. We exchanged publications—again before the war—with 31 foreign universities. The reëstablishment of these exchanges is gradually taking place.

Besides being a working library for the busy physician and surgeon and his daily problems, it has always been our wish to have it a *scholar's library*. Hence we have made a point of procuring medical incunabula, that is, books printed before 1501. The dates of some of the earliest are uncertain as there were at first no title-pages as in our present books, with the title of the book, the name of the author, and the date and place of publication. In fact, at first, there was no consecutive numbering of pages or even of leaves. Later each leaf was numbered consecutively and later still, each page. Later also, at the end, the year and even the day of the month when the book was finished were printed, together with the name of the author and sometimes the mark or design adopted by each printer. The earliest printed medical books date from about 1468. The College Library is rich in possessing 262 of these incunabula and we are adding to our collection from year to year.

Among rare books in our collection is a perfect copy of Harvey's book on the circulation of the blood (*De Motu Cordis et Sanguinis*), published in 1628. Of the forty-two editions of the five works of Harvey the Library of the Surgeon General and that of the College of Physicians are the only libraries in this country or in Europe possessing thirty-three each.

Another rare book is the first printed edition of Celsus (Florence, 1478) with the signature of a former owner still legible—the paternal uncle of Americus Vespucius whose name the New World bears. Another bibliographical treasure is a superb copy of the works of Aristotle in Greek, an Aldine first edition, printed in Venice in 1495–98. Besides these we have some medical books in Chinese, Japanese, Siamese, and Turkish.

One of the especial archæological treasures of the Library is an Assyrian medical tablet, 9 x 14.5 cm.; its presumable date is about seven centuries

B. C. It has a cuneiform text on both sides. It is one of four such tablets, two being in the University of Pennsylvania Museum of Archæology and one in Constantinople, respectively. The Louvre has none.

It was the private possession of a man who was probably a high priest and a medical man. The treatment of disease in those days was purely by symptoms. Headache, then as now, was a very frequent symptom. Its cause was supposed to be a demon or spirit which it was the duty of the doctor to drive out. What more reasonable than to apply poultices or ointments to the head and keep them there for a number of days as is here recommended? [1]

We have also ten thousand portraits of physicians, each available in a few minutes through a card catalogue.

One peculiar and peculiarly useful feature of our Library is twelve small study rooms. Any Fellow engaged in writing an important paper or book requiring literary research, can engage one of these rooms, if one is free, gather his books and papers together, dictate to his stenographer without disturbing others (for the walls of these rooms are of brick and not of lath and plaster) and when he leaves there is no putting away of books and papers or reassembling of them when he returns. When next he comes everything is there as he left it. This saves much loss of time to the author and much wear and tear on the books.

Such a library and such facilities for its use invite to literary activity. Accordingly, for a number of years about ten per cent of our active Fellows, who number 422, have either written or edited a new book or issued a new edition of an earlier one. Such a record is, I suspect, unique.

[1] Jastrow, *Transactions of the College of Physicians of Philadelphia*, 1913. With photographs, transliteration and translation.

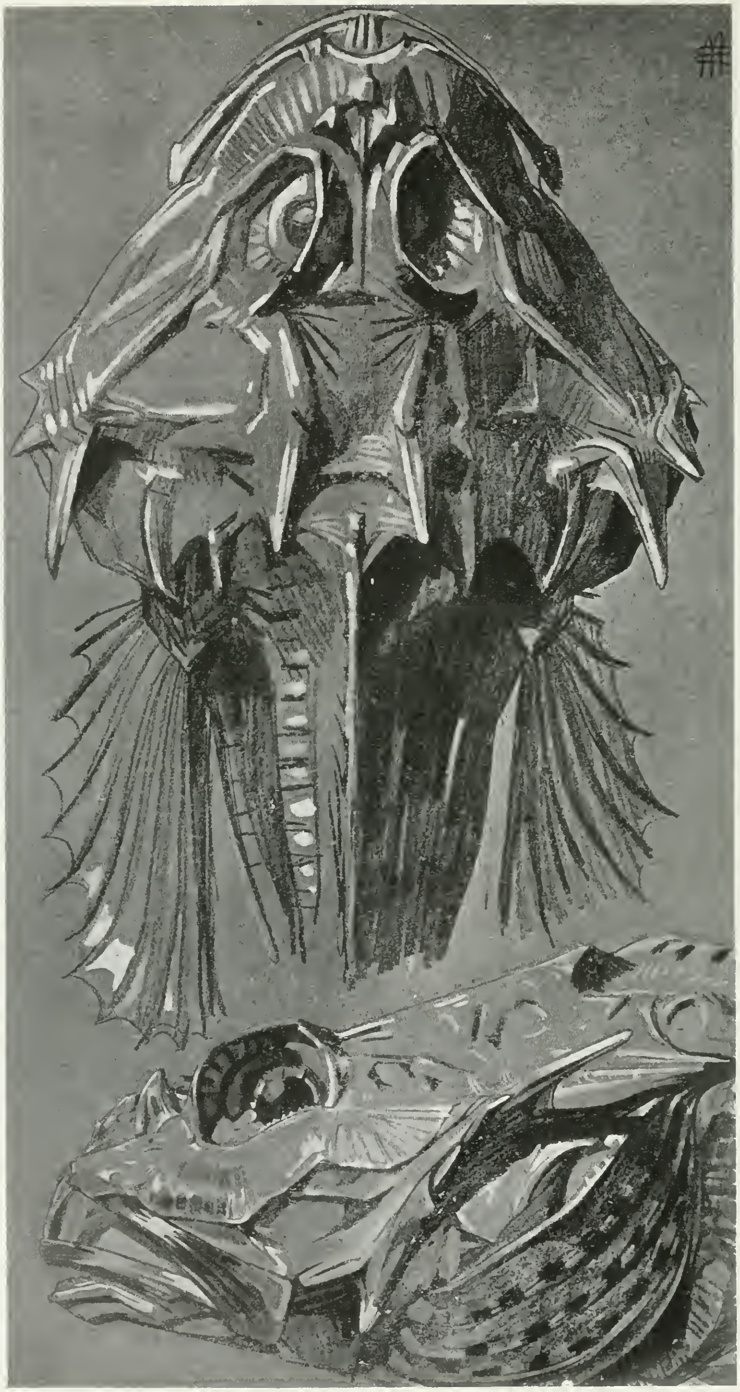
Our card catalogue is entirely typewritten and is kept up-to-date.

So large and active a library requires a considerable staff of librarian, assistants, cataloguers, and messengers. All these activities cost money.

We have been unusually fortunate in having gathered from time to time a special "Fund for Completing Files of Journals," another for "Rare and Valuable Books," and a "Catalogue Endowment Fund." But our principal income for the many activities and expenses of the Library comes from nearly thirty Funds given by Fellows and friends of the College.

Despise not the day of small things. How great a fire a little matter kindleth! Those twenty-four books of John Morgan were prophetic of the present thousands upon thousands.

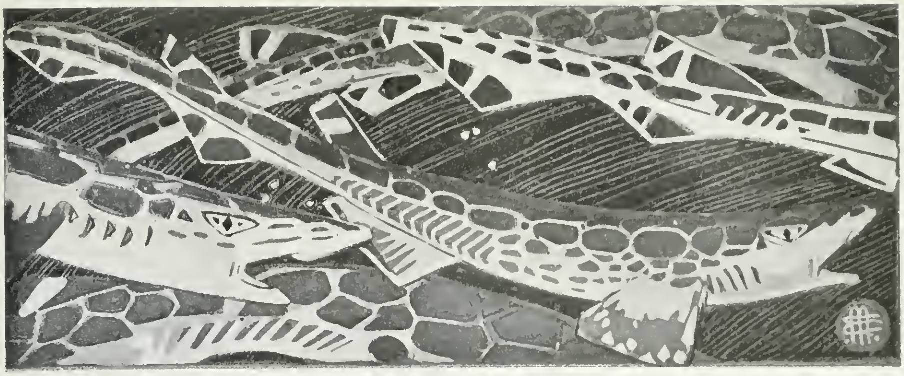
Let not only doctors but communities take courage and *start* a library no matter how small. It will gather friends and funds as a snowball gathers unto itself more and still more snow. Even in 1867 when I was elected a Fellow, the Library was of minor size and minor value and open only a few hours each week. A half century has metamorphosed and invigorated it until now it is open all day and two evenings each week. It is of enormous value to the profession, and through the doctors, who thus are better educated and kept posted up to the very last discovery, it promotes the health and happiness of the entire community. Its use is not restricted to the Fellows of the College. Any doctor and even any one seeking information on a medical subject has this splendid Library at his service upon a proper introduction by any Fellow. It is constantly visited and its treasures utilized by doctors from all over the country, who find in its great resources and the quietude of its study rooms the greatest possibility and encouragement to work.



After Méheut

A STUDY OF SCULPIN STRUCTURE

Suggesting the artist's careful work on the fundamental anatomy of his subjects.—The drawing, made from the dried fish, emphasizes the immense size of the compressed head of this species, brings out the head spines which show obscurely in the living fish (compare with drawings on page 290), and depicts with especial value to the sculptor the planes of the external surfaces of the fish



A very handsome decorative adaptation of the spotted dogfish (note the effect of the triangular eye)

Undersea Forms of Life[1]

Their beauty of line and color and adaptation to purposes of art

By CHARLES R. KNIGHT

American painter and sculptor of animals

THE French artist, M. Méheut, whose books form the subject of this brief review, is evidently a man of great ability with a strong love for his particular work and a manifest desire to make it of use to those who may be interested along similar lines. As a draftsman he shows extraordinary facility and is able to record with accuracy the various forms and attitudes of a host of strange and beautiful creatures found beneath the surface of the sea.

One feels on looking through the pages of these fascinating volumes by M. Méheut that here have been presented to us for the first time really adequate pictures of these denizens of the ocean in all their richness of design and color, and that the artist never loses sight of the decorative possibilities of his subject. Indeed, it is from the latter viewpoint that the drawings will prove of greatest value to the art student's work. In some of the plates the structural details are minutely and accurately depicted, while in others more attention is given to the divers postures and attitudes assumed by the living creatures when feeding, swimming, or resting.

M. Méheut must have expended in many instances a great amount of skill and energy in grasping the salient facts of the poses assumed by various creatures during a very brief period of time. This is especially true in the case of some of the higher forms shown in his plates. The writer has had wide experience in this very field of art and does not hesitate to say that anyone who has so charmingly placed upon paper the numberless attitudes of fishes, crustaceans, and the like, shown in these volumes, must indeed be a master at the game. Take for instance the picture of the blenny, a bottom-living fish found about the French coast. How lifelike is the attitude of the little creature as it sits like a bird upon the sand, supported by the two pectoral fins. One feels instinctively that the drawing is correct, the proportion and the perspective excellent and very difficult to reproduce. How graceful and vivid, too, are the drawings of the great conger eels and the spotted dogfish. They give at once a

[1] *Étude de la Mer,* Faune et Flore de la Manche et de l'Océan. Vols. I–II. Par M. Méheut. Texte par M.-P. Verneuil, Préface par M. Yves Delage, Membre de l'Institut. Librairie Centrale des Beaux-Arts, Paris, 1918.

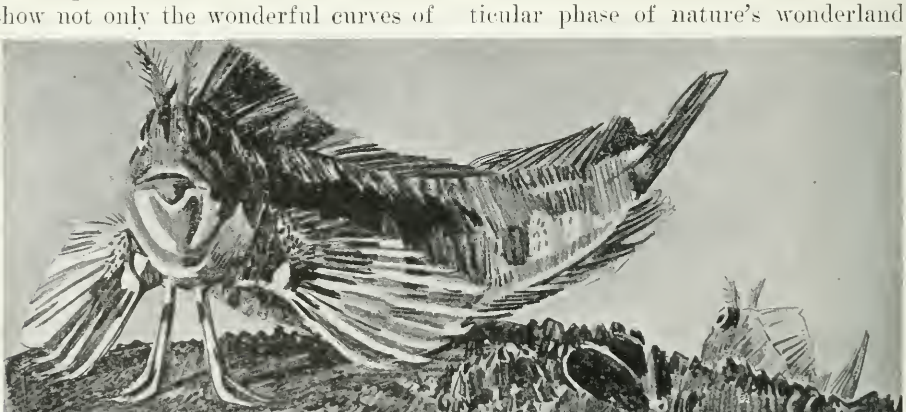
The illustrations of this review are reproduced from Méheut's drawings through the immediate courtesy of Albert Lévy, Éditeur, Librairie Centrale des Beaux-Arts.

sense of power. But it is just this phase of art which is not easily portrayed, for in order to catch such movements one must draw with great speed and proficiency, else the result will be merely a series of meaningless lines. The Japanese artists are supposed to lead the world in this sort of drawing, yet no Japanese has, to my knowledge, been able to catch these fleeting attitudes with so much fidelity. To our Oriental friends, however, must be given the credit of working along very similar lines, and for that very reason they have produced some wonderful drawings in the way of decorative renderings of animate things.

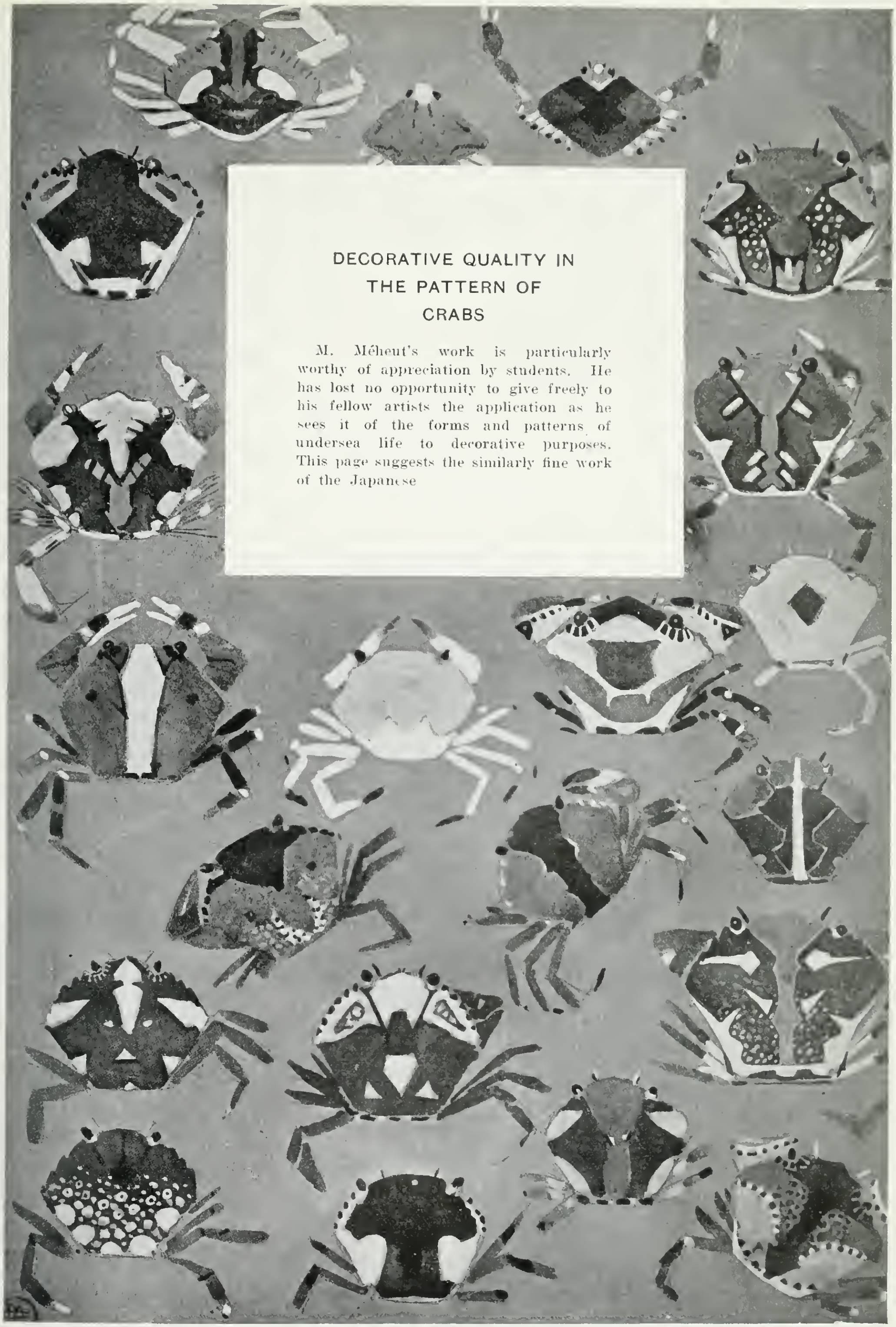
Our artist has given us at intervals through his books suggestions for the adaptation of the types he presents, and I wish to call the art student's attention particularly to these suggestions. In the plates of the various species of skates and rays, as well as in those of the species of crustaceans, one sees at a glance the decorative quality contained therein, and the conventionalized pattern of the fishes themselves is full of color and variety. Too many of our art students, I fear, never learn the immense value in this sort of study—and how characterless and tiresome their work seems without it.

Again in the squid and the octopus drawings much care has been taken to show not only the wonderful curves of the tentacled arms and the strange and sinuous character of these villainous-looking creatures, but the marvelous protective coloration of spots and stripes also comes in for its full share of attention. In other words, M. Méheut in each case gives us, first, splendid studies of the living animal as a help to students in modeling and drawing, and second, a series of color or wash studies in which the complicated and suggestive color patterns are carefully worked out. With these as a guide the interested student is able to acquire a knowledge of exterior anatomy which will enable him to produce virile, interesting, and anatomically possible types for his decorative work, whatever it may be, as well as a wealth of suggestion for color work in design for dress goods, wall paper, or the thousand and one other art expressions to which his fancy or his necessity may lead him.

The volumes, as a careful perusal will show, contain hundreds of drawings of crustaceans, mollusks, and seaweeds, all done in the same splendid manner and all filled with the same spirit of life and animation. It is safe to say that the books are a revelation to the art student as well as to the layman, and should prove of inestimable value to a great number of people who, through lack of interest or opportunity, have not hitherto been aware of this particular phase of nature's wonderland.



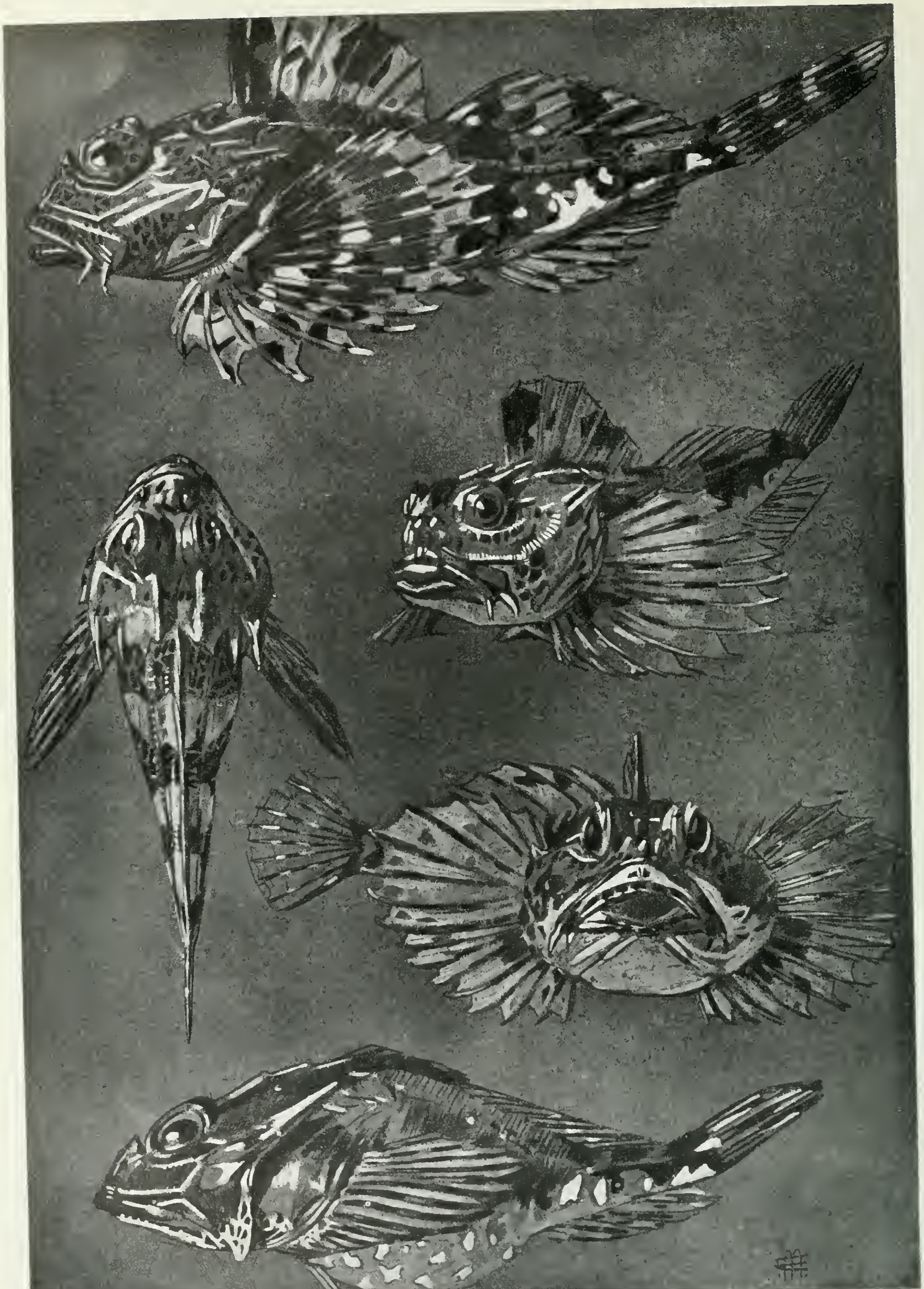
Study of a characteristic life pose: a blenny (*Blennius gallorugine*) resting on its fins in a position suggesting a butterfly



DECORATIVE QUALITY IN THE PATTERN OF CRABS

M. Méheut's work is particularly worthy of appreciation by students. He has lost no opportunity to give freely to his fellow artists the application as he sees it of the forms and patterns of undersea life to decorative purposes. This page suggests the similarly fine work of the Japanese

After Méheut



After Méheut

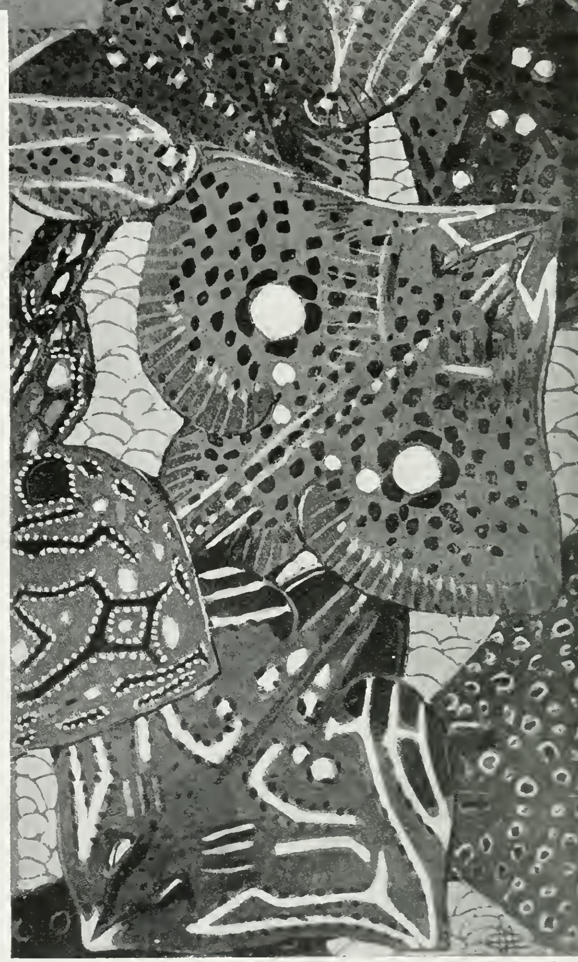
LIFE STUDIES OF THE SCULPIN

Accurate structure and life postures, yet decorative in effect.—M. Méheut gives many pages to life studies of this "bullhead of the sea"—in profile, head on, aggressive, in repose, lying in wait under the rocks "like a brigand in his cave," alert with fins bristling guarding the eggs. The page devoted to the color and color pattern of this species is one of the most effective pieces of work in the two volumes

FLAT COLOR DECORATION FOR TEXTILE DESIGNERS

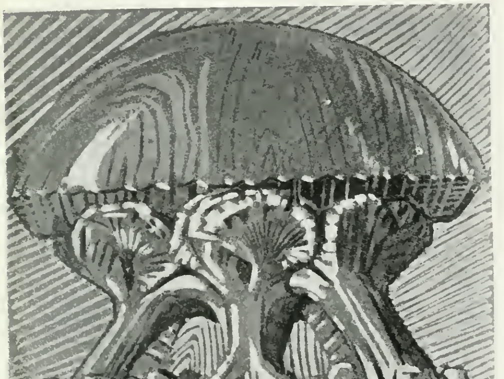
The artist here calls attention to the wonderful decorative quality in the color patterns on the backs of certain species of rays—fishes of the sea bottom. It is unfortunate that we cannot reproduce the color plate portraying the decorative quality of skate color patterns. Such patterns are most charming in effect but are drawn with difficulty. The rays, like the sculpins and the blennies, served the artist as inspiration for many pages of suggestive studies.

On looking through the fascinating volumes one feels that here have been presented to us for the first time really adequate pictures of these denizens of the ocean in all their richness of design and color



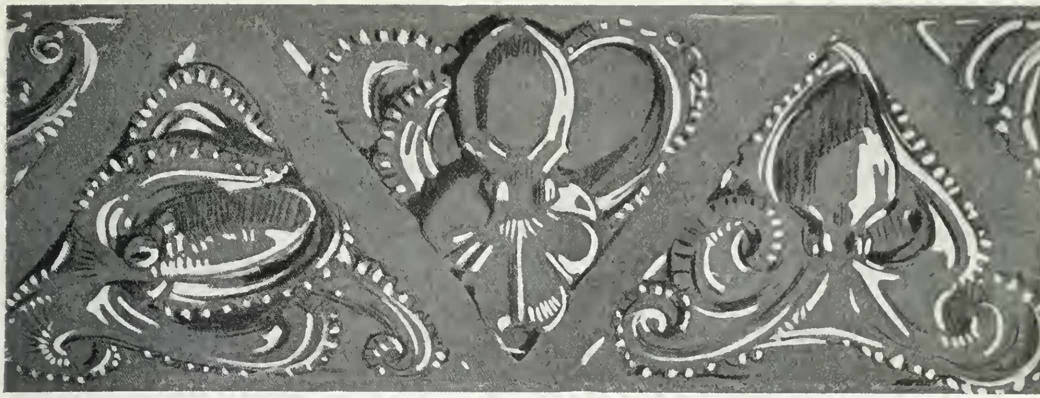
After Méheut

Decorative application of the goose barnacle (*Lepas anatifera*) by M. Méheut



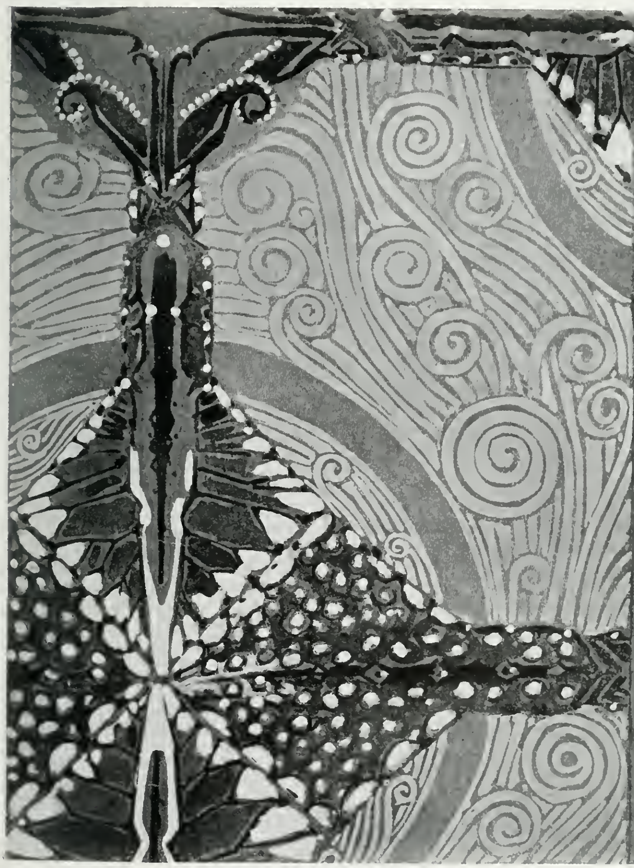
Drawings after Méheut

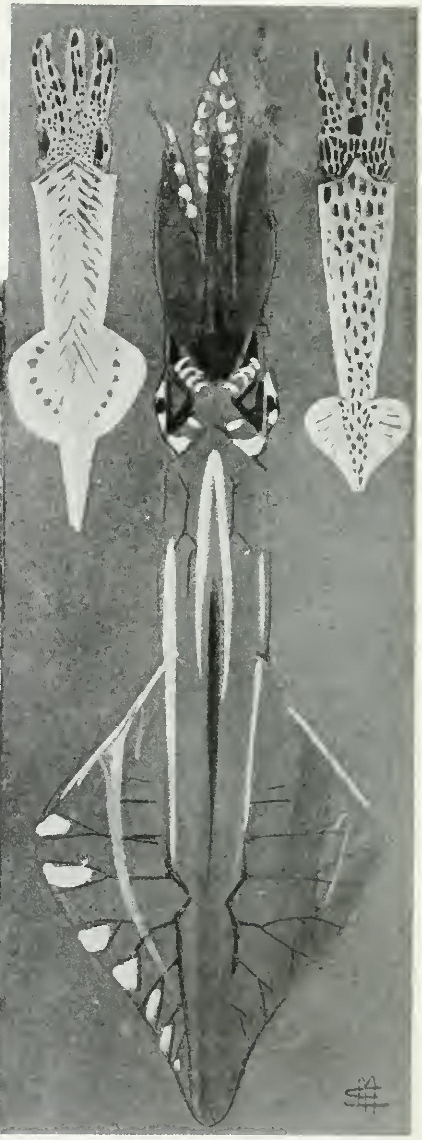
Adaptation by M. Méheut which brings out the decorative quality in the form of the jellyfish. The study at the right is especially applicable to painting and flat surfaces, that at the left to sculpture



MARINE MOLLUSK FORM IN DECORATION

The study above suggests decorative qualities of the octopus; that below gives a unique and charming decoration based on the form and color pattern of squids





After Méheut

Courtesy of Underwood & Underwood

THE CREATOR OF A PEOPLE'S PLAYGROUND

George W. Perkins has an imperishable monument in the Palisades Interstate Park, a recreation ground of 35,000 acres which is a partnership between the states of New York and New Jersey for the people on a noncommercial basis.

In 1899 the Palisades along the Hudson opposite New York were being destroyed by quarry interests. The late Theodore Roosevelt, who was then Governor of New York, appointed a commission with George W. Perkins as president, to coöperate with a commission appointed by the Governor of New Jersey. Mr. Perkins' first step was to buy an option on the quarry interests with the $10,000 granted the commission at the time of its appointment "for expenses." The late Mr. J. P. Morgan gave the $122,500 needed to buy the property and on Christmas Eve, 1900, the destruction ceased. The Palisades Interstate Park thus started as a conservation movement

George Walbridge Perkins, 1862-1920

By GEORGE FREDERICK KUNZ

President of the American Scenic and Historic Preservation Society

IT was in connection with the creation of the Palisades Interstate Park that George W. Perkins, who died on June 18, 1920, first came prominently into public notice. Previous to that time he had been taking an increasingly important place in the insurance world. Born in Chicago on January 31, 1862, and beginning as an office boy at $300 a year in the Chicago office of the New York Life Insurance Company, he had risen by the year 1900 to the position of chairman of the Finance Committee of that company, whose main headquarters were in New York. This brief statement is a sufficient indication of his business genius.

In order to understand the turning point in his career in 1900, at which time he not only enlarged his sphere in the financial world but also entered upon what may properly be described as his public activities, it is necessary to recall that for several years prior to that date there had been a growing agitation to prevent the mutilation of the Palisades of the Hudson River by trap-rock quarrymen who were blasting away the face of the cliffs opposite New York City for road-making material. Various plans for a state, interstate, or national park covering the Palisades area had been proposed, but without results. In 1895 an effort more determined than ever was made. In that year Andrew H. Green secured the incorporation of the American Scenic and Historic Preservation Society, whose charter authorized it not only "to acquire . . . historic objects or memorable or picturesque places," but also to "act jointly or otherwise with any persons appointed by any other state for similar purposes . . . whenever the object to be secured or purpose sought to be accomplished is within the jurisdiction of this and any other state or can only be attained by such joint action." This provision distinctly contemplated the preservation of the Palisades.

In the same year the Legislature passed an act for the appointment of a commission to confer with a like commission from New Jersey concerning the preservation of the Palisades. The plan then evolved was for a national park, and in 1896 the Legislatures of the two states authorized the cession to the United States of jurisdiction over the Palisades upon purchase by the Federal Government for a military and national park and for the protection of the cliffs, trees, etc. A bill was also introduced in Congress for the purchase of the land, but never passed, and this plan failed.

On June 17, 1899, Governor Roosevelt wrote a letter to Andrew H. Green, president of the American Scenic and Historic Preservation Society, asking him to appoint a committee of five to act in behalf of the state of New York in conjunction with the commission appointed by Governor Foster M. Voorhees, of New Jersey, to devise measures for preserving the Palisades. Mr. Green accordingly named Frederick W. Devoe, George F. Kunz, Frederick S. Lamb, Abraham G. Mills, and Edward Payson Cone as such commissioners. They engaged desk room at the headquarters of the Empire State Society of the Sons of the American Revolution, No. 1123 Broadway, New York City, and during the next seven months held frequent joint conferences with the New Jersey commissioners: F. W. Hopkins, Miss Elizabeth Vermilye, W. A. Linn, S. Wood McClave, and Miss Cecelia Gaines.

On December 12 of this same year (1899) the New York commissioners transmitted to Governor Roosevelt a report outlining a plan for the creation of the Palisades Interstate Park, and in his message to the Legislature, January 3, 1900, Governor Roosevelt said:

> "The State should sedulously preserve for its people the natural beauties within its limits. Great good has been done by the Niagara Falls Reservation, and its interests should be advanced in every way. I call the attention of the Legislature to the report of the Palisades Commission, which has my hearty approval. The Palisades should be preserved. They form one of the most striking and beautiful features of nature in the entire country, and this marring and ruin should be a source not merely of regret, but shame, to our people. New Jersey is in real-

ity less interested in their preservation than we are, although they are in her territory, but their beauty can best be observed from ours.

"There are two miles of the Palisades in the State of New York and ten in the State of New Jersey. No further riparian rights along their base should be granted, and I suggest that a Commission to represent the State of New York be appointed, and that the Governor be empowered to request the State of New Jersey to appoint a similar commission to serve with ours and endeavor to provide for joint action by the two States to secure the permanence of this splendid monument."

On January 15, 1900, Senator Parsons, without the approval of the commissioners, introduced in the State Senate a bill providing that when the United States had acquired property for that purpose to the value of $250,000 or any part thereof, the state of New York should reimburse the Federal Government for its expenditure, but this bill was withdrawn when, on February 1, Assemblyman Gherardi Davis and Senator N. A. Elsberg, at the request of the American Scenic and Historic Preservation Society, introduced a bill "To provide for the selection, location, appropriation and management of certain lands along the Palisades of the Hudson River for an interstate park and thereby to preserve the scenery of the Palisades."

The Davis-Elsberg bill became a law (chapter 170 of the laws of 1900) on March 22, and soon after that New Jersey enacted a corresponding bill. On April 2, Governor Roosevelt named as five of the ten commissioners provided for in the bill, George W. Perkins, D. McN. K. Stauffer, J. Du Pratt White, Ralph Trautmann, and Nathan F. Barrett, of New York State. Governor Voorhees accepted these nominations and named Abram S. Hewitt, Edwin A. Stevens, Franklin W. Hopkins, William A. Linn, and Abram De Ronde, of New Jersey, as the other five. On May 18, 1900, Governor Roosevelt also appointed the latter as nonresident commissioners, thus completing the commission.

The commission, in its capacity as representing the state of New York, organized with George W. Perkins as president, a position which he retained until his death twenty years later. In recognition of the prompt, energetic and effective manner in which Mr. Perkins took up his task, he was elected a trustee of the American Scenic and Historic Preservation Society on December 1, 1900. On December 5 he requested the society to appoint a committee to confer with the Palisades Commission and this cordial coöperation of the commission and the society has continued ever since.

At the very beginning, Mr. Perkins brought his genius to bear successfully on the complex problem. His first object was to stop the destructive work of Carpenter's quarry. The property was held at $132,500. With the $10,000 appropriated for expenses he secured an option and set out to raise the rest by private subscription. He went to the late J. P. Morgan expecting to get about $25,000, and Mr. Morgan gave the whole $122,500. Blasting was stopped on Christmas Eve, 1900, and the first great step was accomplished.

It may be said here, parenthetically, that another result of this contact between Mr. Perkins and Mr. Morgan was an invitation from the latter to the former to become associated with him in business. The invitation was accepted and this important business connection continued for several years.

Since this original purchase of the quarry in 1900 the work of enlarging and developing the Palisades Interstate Park has gone forward with phenomenal success until the park area now embraces about 35,000 acres. During these twenty years the commission has received about $6,000,000 from the state of New York, about $600,000 from the state of New Jersey, and more than $6,000,000 in money and land from private contributors. Among the most generous of these contributors were Mrs. E. H. Harriman, J. P. Morgan, John D. Rockefeller, John D. Archbold, George F. Baker, Cleveland H. Dodge, Elbert H. Gary, Mr. and Mrs. Arthur Curtiss James, V. Everit Macy, James McLean, Frank A. Munsey, George W. Perkins, Henry Phipps, William Rockefeller, Mrs. Russell Sage, James Stillman, E. T. Stotesbury, and William K. Vanderbilt.

The Palisades Interstate Park was formally dedicated with ceremonies held at Alpine, New Jersey, on September 27, 1909, in connection with the Hudson-Fulton Celebration. In the absence of General Stewart L. Woodford, president of the Hudson-Fulton Celebration Commission, the writer officially represented the commission in the ceremonies. The Honorable Edwin A.

PLANNING FOR THE PARK

Mr. Perkins and Major W. A. Welch, chief engineer and manager. — They were optimists, willing to work hard for the end in view. "I never wavered one moment in my faith," said Mr. Perkins, "that although forty-five miles from New York, we could make this the most populous park in the world, because I knew that there were hundreds of thousands of tenement children in New York who needed an invigorating sojourn in these beautiful hills." Seven hundred visitors was the maximum for any Sunday the first year (1914): now there may be 40,000 for one day, in addition to those who are settled in the various camps

ALONG THE FOOT OF THE PALISADES

There are no artificial scenic effects in the Palisades Interstate Park. The natural and the historic have been left intact, except that way has been made for entrance and enjoyment. A twelve mile trail leads along the shore between Fort Lee and the interstate boundary line. There are recreation pavilions and picnic grounds, wide beaches, a motor-boat basin, a bath house (2000 lockers), docks, free boats, camping grounds. The work has been done by the commission's staff of engineers with no letting of contracts, and, during the twenty years' existence of the commission, no commissioner has received any monetary compensation for his services

The "Playground" and Bear Mountain Inn.—One must send for the pamphlets and reprints of the Palisades Interstate Park Commission (90 Wall Street, New York City), and then visit the park, to gain any adequate idea of what has been accomplished in creating here a great free people's playground. Just the story of the construction of drives and trails, play fields, camp plateaus, and a wide beach opposite One Hundred and Fifty-eighth Street is a fascinating chapter of the work; for not only was the native rock used, but also stone from the excavation of the New York subway, the waste screenings from stone crushers, and the street sweepings of New York City

In the twenty years since the original purchase of the Palisades quarry, the development of the park has been phenomenal, with a long list of generous contributors (see page 296). Among the most notable gifts was 10,000 acres, with a contribution for its development, presented ("with the hope that through all the years to come the health and happiness of the generations will be advanced") by Mr. W. Averell Harriman acting for his mother and "in accordance with the long-cherished plan" of his father, the late E. H. Harriman

Mr. Perkins' chief interest was in the park's camp system which lay directly in the line of his ideal for social service. There are more than fifty standardized camps with mess hall and sleeping cabins, equipment for pure water supply and cleanliness, accommodations for swimming and boating and other out-of-door sports. There are Boy Scout, Girl Scout, and Y. W. C. A. camps, and camps for children from settlement houses and churches, and from such organizations as the Brooklyn Industrial School for Destitute Children. In connection with the camp life there are such educational features as camp libraries, lectures, concerts, motion pictures, and natural history exhibits

Mr. Perkins tells of the camps in his own words in *Motor Travel* (December, 1918), especially of Camp Globe where more than a thousand tenement children, averaging a stay of two weeks each, are entertained each season by the Association for Improving the Condition of the Poor in coöperation with the New York *Globe*. "I could go on indefinitely—it is my favorite theme—to tell you of these children, and how the Commission transports them the *longest way* over the mountains to thrill them with the auto ride; how they are watched over by kind, intelligent counselors; how they hike through the woods and learn the calls of the birds; of the food they eat, and the cabins in which they sleep through the still nights; about the lakes in which they swim and the boats in which they ride; the camp fires around which they sing." Through his energy and executive ability in building the Interstate Park, Mr. Perkins has prepared a controlling social power for the future

Stevens presided; the present Very Reverend Dean Howard C. Robbins made the invocation; Mr. Perkins, Governor Hughes, Governor Fort, of New Jersey, and the writer gave addresses. At the close of the ceremonies the United States flag was raised to a salute from the warships in the river.[1]

An interesting feature of the development of the park was the acquisition of the sites of Fort Clinton and Fort Montgomery lying respectively on the southern and northern sides of Popolopen Creek at its intersection with the Hudson River. This is at the extreme northern end of the Palisades Interstate Park about a mile north of Bear Mountain Inn. Some traces of Fort Clinton remain; and when evidences of the works of Fort Montgomery were found in the dense thicket which covered that site, the commission invited Dr. Edward Hagemau Hall and Mr. Reginald Pelham Bolton, the former secretary and the latter a vice president of the American Scenic and Historic Preservation Society, to make an archæological survey of the fort site. This they did in 1916, having the coöperation of the commission's chief engineer, W. A. Welch, and also of W. A. Calver, a member of the society. Their researches, covering a period of several months, relocated the boundaries of the fort, which covered an area about a third of a mile square, identified more than half of the breastworks, with their numerous salient and reëntrant angles, and by vestiges and evidences too technical to give here in detail accurately plotted the whole outline. In many places they found the actual embrasures of the cannon. Within the fort they identified the foundations of the barracks of the Continental soldiers, the magazine, and other buildings, one of which was probably the headquarters of General George Clinton at the time when he was elected first governor of the state of New York in July, 1776. Since this survey, the Palisades Interstate Park Commission has had much of the underbrush of the fort site cleared out so that the old ramparts on the eastern and southern sides along the bluff overlooking the Hudson River and Popolopen Creek may easily be visited.

While the Palisades Interstate Park embodies Mr. Perkins' most memorable public work, he had many other public activities during the last twenty years. He was a warm admirer and close friend of Theodore Roosevelt and exerted a directing influence in the organization of the Progressive Party, of whose National Executive Committee he was chairman.

During the World War, he was chairman of the Finance Committee of the National War Work Council of the Young Men's Christian Association, and it was largely due to his consummate leadership that the great sums were raised throughout the United States for welfare work.

He belonged to a hundred or more financial, art, civic, educational, scientific, political, and benevolent organizations, his activities in or sympathy with which were an indication of the wide horizon of his outlook on human affairs.

All who came in contact with Mr. Perkins were strikingly impressed with his deep insight, his honesty of purpose, and his directness of approach to any subject. His energy and enthusiasm inspired in others the confidence he felt himself, and he was always the first to give of his money or time to any object that he endorsed. He "spared not himself," but gave of the best that was in him; and whether his immediate interest was the Palisades Interstate Park, the National War Work Council of the Young Men's Christian Association, or the many other objects with which he was connected, it always met with more than ordinary success because of the force of the personality behind it. No one disputed his splendid leadership. He inspired in all who worked for him or with him the feeling that they would receive a just share whether in financial returns or credit for an enterprise: they trusted him. Surely no greater monument exists to the honor of any of our citizens than the Palisades Interstate Park, a wonderful tract of land adjacent to the greatest metropolis of this continent—and its value will increase with the passing years and with the succeeding generations.

[1] The proceedings are given in full in the two-volume official report entitled *The Hudson-Fulton Celebration*, 1909, pp. 392–412. See page 404 as to origin of the bill.

"Army Mental Tests"—A Review[1]

PART RIDDANCE OF CHANCE IN THE CHOICE OF A VOCATION, THROUGH TESTS OF APTITUDE IN CHILDREN, WILL IN THE FUTURE HELP TO ELIMINATE OCCUPATIONAL "MISFITS" AND INDUSTRIAL UNREST

By RICHARD M. ELLIOTT

Associate Professor of Psychology, University of Minnesota

THE remarkable success of mental examination methods introduced by psychologists into the United States Army during the war has naturally become a stepping-stone to further achievement in the technique of mental measurement. With the cessation of hostilities the blanket of secrecy which was enforced under the provisions of the Espionage Act in order to secure absolute control over the production and distribution of test materials was immediately lifted in favor of a policy of widespread publicity. Surplus test blanks and other materials offered for sale by the government were eagerly bought by persons anxious to complete intelligence surveys comparable with the findings of the army examiners.

The Surgeon General of the army further permitted the publication of a handbook, *Army Mental Tests,* editorially supervised by Majors Robert M. Yerkes and Clarence S. Yoakum, which reproduced all the test blanks and printed materials employed in the army examining, with minor exceptions where the material was already available. Exhaustive directions for giving the tests, a brief account of the inception and development of methods, a review of typical results, and some pages on the general significance of the unexpected impetus given intelligence examinations by their military use, complete an indispensable handbook and examiner's guide.

With this book already available, and awaiting the elaborate account of the achievement which it represents to be published in the autumn by the National Academy of Sciences, it may be worth while to consider some of the wider bearings of the large-scale development of differential psychology comprised in the mental test movement.

Scientific assignment of human energies in the furtherance of the aims and interests of an industrial democracy can proceed only step by step with the development of a technique for their scientific appraisal. The immense preponderance of chance factors at present determining the choice of vocation and occupation results in a deplorable percentage of misfits. Here is the soil of an unrecognizedly large portion of that contemporary social disorganization which is at once a taunt to our claim of living in a scientific age and a matter of growing concern to all thoughtful persons eager to forestall and obviate the dangers of industrialism triumphant.

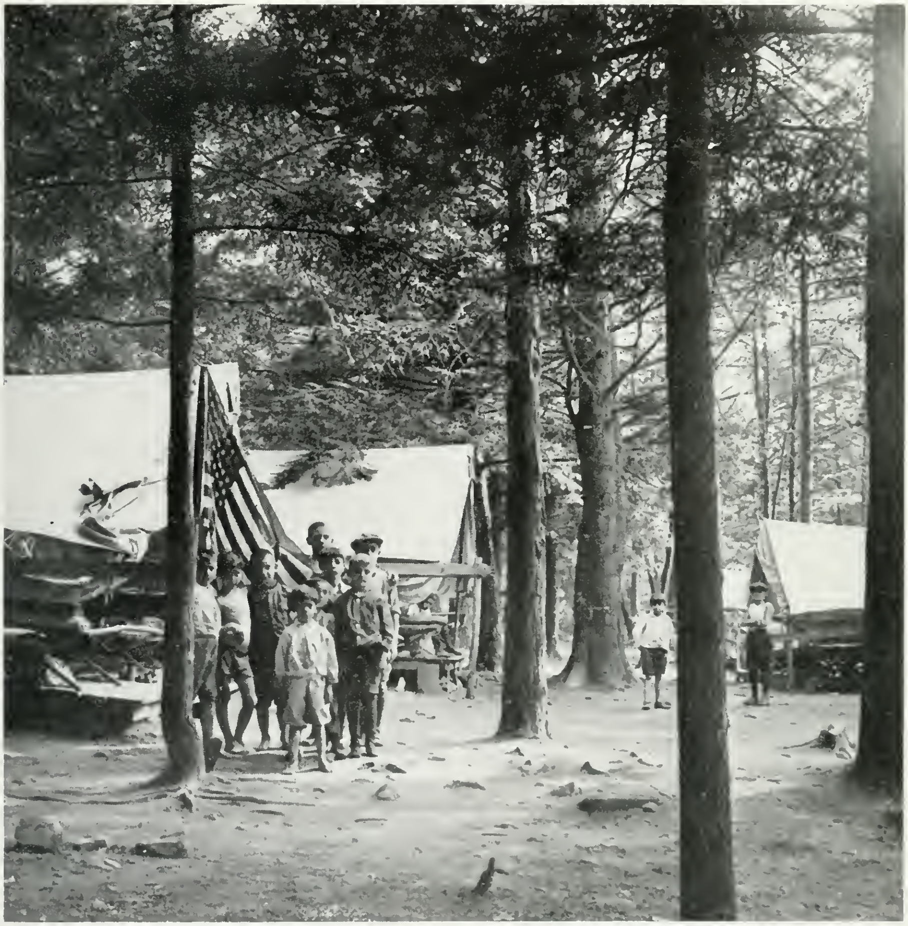
Admittedly the newer technology of "human engineering," as it already functions, for the most part unlabeled, in the fields of business and education, is usually but the servant of arbitrary and traditionally favored procedures and purposes. In the absence of social self-consciousness of the sort that Plato dreamed about, inertia and chance inevitably preponderate in the determination of directions. But only excessive cynicism would refuse to admit that once confidence in methods of sufficient accuracy is justified, wide expansion in the field of their application will follow.

It should lie within the technical power of a well-advanced differential psychology to discover and measure the relative strengths of vocational and occupational aptitudes and proficiencies in young children. Misfits will become predictable, even those arising from temperament. Then slowly we shall outgrow the notion that there is anything

[1] *Army Mental Tests,* compiled and edited by Clarence S. Yoakum and Robert M. Yerkes. Published with the authorization of the War Department. Henry Holt and Company, New York, 1920.

inherent in the idea of democracy necessitating identity of early school training. And with proper differentiation in the training for all those branches of service,—professional, industrial, and artisan,—upon which society depends, we shall make definite progress toward social harmony. This will be achieved as the consequence of individual appropriateness in the placing of men so that their own measure of interest in creative activity of whatever sort is realized, without exploitation, to the full benefit of themselves and of society.

To prognosticate further about the ultimate contribution of differential psychology, so far as it is comprised by the measurement of individual differences in makeup, might conceivably divert attention from its immediate practicality. The work of the corps of mental examiners in the army, however, demonstrated against any reasonable objection the advantage of supplementing personnel work with the data of intelligence examinations, where large unsorted masses of men must be quickly and effectively organized. For many years it will remain the most extensive survey. Appropriately the examinations most largely used were named, for convenience, the Alpha and Beta examinations, symbolic, let us say, of the long line of development which is to follow the pioneering task, for which not even the tools were at hand when first a group of courageous psychologists apprehended the nation's need and proposed a technology for meeting it.



A further scene in the camp life at the Palisades Interstate Park (see page 300)

THE WORK OF A GREAT LANDSCAPE ARCHITECT, AT BUENOS AIRES

Buenos Aires, the largest Spanish-speaking city of the world, was founded in 1541 on the rich pasture land of east central Argentine. Although there are no native forests within many miles, the naturally rich soil and favorable climate have made it possible for a far-seeing government to turn the avenues, squares, and parks of the city into gardens of flowers and trees which bloom throughout the winter. Shady walks and banks of flowers along the water's edge greet the visitor as he approaches from the sea, and spacious boulevards with gardens on either side or down the center conduct him through the city. There are approximately one hundred parks and squares, laid out with forethought and the best skill of the landscape artist. The landscape engineering work has been directed by Señor Carlos Thays who founded the model Botanical Garden where is assembled a large assortment of native and exotic plants arranged not only for beauty but for instruction also

Penguins, in the Buenos Aires Zoölogical Garden, native to the southern part of the continent.—The Zoölogical Garden at Palermo Park has been made in recent years one of the most artistic of its kind in the world, and a most delightful retreat for recreation or instruction. It is unusually rich in its display of South American animal life and possesses a notable collection of llamas, guanacos, and anteaters

Parks and Gardens of Buenos Aires[1]

By F. LAMSON-SCRIBNER

Expert on Exhibits, Department of Agriculture, Washington, D. C. Author of numerous bulletins and articles on botanical and agricultural subjects

THERE probably is no country in the world, not even excepting our own, where civic and rural progress and development have taken place more rapidly during the last twenty years than in the South American republic of Argentina.

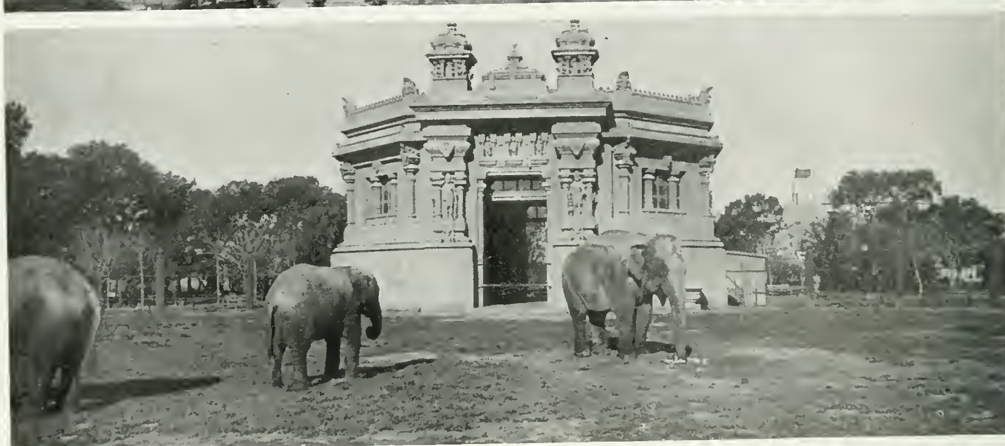
The area of Argentina is as great as all of the United States east of the Mississippi, or six times the area of France. From north to south the range of climate is very great. One may broil in Formosa where conditions are tropical, or freeze in southern Patagonia where the latitude south corresponds very nearly with that of Moscow, Russia, in the north. To this great range in latitude should be added the differences in altitude from the broad plains along the shores of the Atlantic westward to the Cordilleras, some of whose peaks attain the height of 6000 meters or more. The rainfall varies no less than the physical features of the land. There are desert areas, vast treeless plains, and immense forest-covered regions. The flora of the Argentine is exceedingly rich in species and the abundance of its agricultural products places the Republic in the front rank with nations bidding for the world's commerce.

The journey from New York to Buenos Aires, by boat, as we made it, is a twenty-five-day run with brief stops at Bahia, Rio de Janeiro, and Santos, Brazil.

We arrived at our destination on April 30 at the beginning of the winter season, but the climate of Buenos Aires is so mild that flowers bloom in the open parks throughout the winter, and although it may be chilly at times, frosts very rarely occur. Deciduous trees like plane trees and elms shed their leaves, but palms, araucarias, eucalyptus species, magnolias, and the like, afford constant verdure and shade.

The capital of Argentina is one of the busiest cities of the world,—a city of beautiful business streets, broad avenues, palatial residences, magnificent club houses and theaters, delightful parks, and shaded boulevards. Its gardens are of unrivaled beauty and interest. There are approximately one hundred of these parks and squares varying in size from two or three acres to the great Palermo Park which is 2660 acres in extent.

[1] Presented at the meeting of the Botanical Society of Washington, January 5, 1920. Illustrated by one hundred and fifty stereopticon slides from negatives by the Author.



SCENES IN THE ZOÖLOGICAL GARDEN, BUENOS AIRES

It is said that the Zoölogical Garden of Buenos Aires is the finest example of landscape gardening in South America. The aim has been to reproduce as nearly as possible the natural environment of the animals, and also to create throughout the garden beautiful scenes and vistas. Reproductions of ancient temples, artificial grottoes, and rocky caverns, set among shrubs and trees, add to its picturesque scenery. The upper photograph shows the great out-of-door bird house

There are no trees save those introduced and planted by man within many miles of Buenos Aires, no hills and no rocks even, and all that has been done to make the city beautiful and its parks and squares a perpetual delight has been accomplished by a far-seeing civic administration and by well-directed efforts inspired by a keen sense of the beautiful and the pride of intense patriotism.

Nature has furnished here ideal conditions for plant growth—a rich soil, a temperature ranging between 40 and 90 degrees, and ample rainfall of 34 inches. From this point the work has been carried on under the guidance of the celebrated engineer, Carlos Thays, director general of public parks and founder and director of the Botanical Garden of Buenos Aires.

One almost immediately steps from the ship landing at the North Basin into a garden rich in flowers and shrubs and trees interspersed with beautiful monuments and fountains. One of these fountains, at the foot of Calle Cangallo, executed by an Argentine artist, Lola Mora, is particularly handsome. This garden is really Parque Cristobal Colon, Paseo de Julio and Paseo Colon which run into each other. Located along the water front, these walks and plantations of flowers and trees create a most favorable impression upon new arrivals and afford a pleasant resort and resting place to those living near by in a most crowded section of the city. An avenue runs through the middle of Cristobal Colon with gardens on either side laid out in the Renaissance style, the whole being designed on the plan of the Champs Élysées at Paris.

Passing through these gardens on our way to our hotel on Avenida de Mayo we come to Plaza de Mayo or Plaza Victoria. In our country we would doubtless have named this Independence Square. The independence of Argentina was declared here on May 25, 1810, and this Plaza has been the scene of many demonstrations of historical interest during four generations. It is about four acres in extent and is tastefully laid out with walks, flowering plants, and shade trees.

The Government Palace, the "White House" of the Republic—where the President and his Cabinet have their offices—faces the east side of the Plaza de Mayo; from the opposite side one passes into the magnificent Avenida de Mayo which leads straight to the Capitol or Congress Hall, a mile and a half to the west. Avenida de Mayo is one hundred feet wide, with broad pavements bordered with plane trees from Europe. This is the "show" street of the city and contains many fine buildings, including hotels, club houses, publishing houses, restaurants, as well as many large retail establishments.

At the western extremity of Avenida de Mayo is one of the largest and most beautiful squares in the city, upon which the Capitol building fronts, facing east toward the Government House. This plaza contains 17,446 square meters and was laid out in 1910 at a cost of 11,000,000 pesos, gold. It is known as Plaza del Congreso or Congress Square, and is the crowning glory of the efforts of Director Thays in beautifying the city. The hand of the master is clearly manifest in the intelligent selection and artistic grouping of the shrubs and trees, and the pleasing landscape effects that meet the eye.

In the newer parts of the city broad and roomy streets are most common but in the older sections many of the streets are quite narrow with sidewalks hardly wide enough for two persons to walk abreast. Such a street is Calle Florida, the most fashionable shopping thoroughfare, which we will now traverse on our way to the great city park, Palermo.

Calle Florida has been called the Bond Street of the Argentine. It is lined with elegant shops, and here are located a number of costly buildings, including the famous Jockey Club, whose exterior is of the finest architectural design and whose interior is sumptuous in the extreme. The street is only twenty feet wide. Between four and six o'clock in the afternoon all traffic is suspended and the entire street is given over to pedestrians.

Leaving Calle Florida at its northern terminus we enter Plaza San Martin, in the center of which is the fine equestrian statue of the famous liberator, General San Martin. This square is well provided with shrubs and shade trees. There is here quite a pretentious piece of rock work that includes a miniature lake and a rustic bridge. A number of fine buildings surround Plaza San Martin, the most conspicuous being the elegant Plaza Hotel.

IN PALERMO PARK

Among the many parks and shaded boulevards of Buenos Aires the park at Palermo, reached by a three-mile drive from the business center of the city, is the largest and most popular. Palermo Park comprises more than two and one half thousand acres, and contains many beautiful drives, pathways, and artificial lakes; it is kept perennially verdant with palms, araucarias, eucalyptus trees, and magnolias

From this point we will proceed to Palermo Park by way of Calle Alvear, but before leaving the "down town" section of the city, let us pay a very brief visit to Lezama Park and Plaza Lavalle or Liberty Square. Lezama Park is located to the south in one of the most populous parts of the city near the Boca. It has extensive avenues of shade trees, a great variety of shrubs, and a large number of beds of choice flowers. Here are many rare plants of botanical interest. Shady groves and open playgrounds give pleasing variety to the whole design. A small historical museum contains much to interest the visitor.

Plaza Lavalle or Plaza de Libertad, as it is sometimes called, is among the prettiest in the city. It is remarkable for the sunken gardens which enter into its plan of construction. The Palace of Justice and the Municipal Opera House or Teatro Colon, which, it is said, is the most beautiful theater in all America, are on this square.

Leaving Plaza San Martin we continue our journey through Calle Alvear, one of the finest avenues in a residential section lined with palatial homes, and soon arrive at Recoleta or Plaza Intendente Alvear, one of the smaller parks of the city, but filled with interesting plant species and differing from other parks visited in its broken or almost hilly surface. There is a small stream with a miniature cascade running through the grounds, affording an opportunity for the culture of aquatic plants and the building of rustic bridges.

Continuing westward through Avenida Alvear, we soon reach the pride of Buenos

Aires, Palermo Park. We halt at Avenida Sarmiento where the great park of more than two thousand acres opens out on our right. To the left lies the Zoo and, near by, the Fair Grounds of the Rural Society and the Botanical Gardens.

Palermo Park is to Buenos Aires what the Bois de Boulogne is to Paris, Central Park to New York, or Golden Gate Park to San Francisco. It contains many drives and walks, and a number of small lakes. Many different kinds of trees and shrubs have been planted along the drives and about the miniature lakes, and evidently much attention has been given to the development of pleasing landscape effects. The Avenue of Palms is well known to every Buenos Airen, who here on Sundays and holidays comes out for a walk or a drive.

Across Avenida Alvear from Palermo and on the right of Avenida Sarmiento, are the grounds of the Exposition of 1910. The buildings were lightly constructed for temporary service. The main entrance was on Avenida Sarmiento. The great palms about this entrance were transplanted during the period of the Exposition. Local florists made a remarkably fine display of ferns, orchids, and other choice flowers in the Horticultural Palace located inside the grounds.

On the same side of the avenue toward Calle Santa Fe, where it is bordered with tall eucalyptus trees, are the permanent fair grounds of the Argentine Rural Society. These grounds cover an area of about forty-five acres, are very prettily laid out, and are equipped with many substantial and attractive buildings for housing the horses and cattle and general exhibits. The reviewing stand is a permanent structure of steel and concrete, and here are held annually, usually in September or October, agricultural and live-stock shows which would compare favorably with the best held in this or any other country. The native Argentinian is a great lover of horses and the displays of fine horses of all breeds or classes are especially good.

Within the grounds of the Rural Society, at the corner of Plaza Italia and Calle Santa Fe, is located the permanent Agricultural Museum. The building constructed for this museum is of excellent design, well lighted and admirably adapted for the display of the large and varied collections of agricultural products that have been gathered here from all parts of the republic. The object of the museum is to exploit the agricultural resources of the country and afford instruction in matters of agricultural interest. The exhibits, numbering more than 20,000 specimens, are attractively installed and well labeled. They are divided into six classes, namely: (1) Natural Products—woods or timber, soil, etc., (2) Agricultural Products—cereals, oleaginous, medicinal, narcotic, and textile plants, nuts, tubers, fruits, etc., (3) Animal Products—wool, skins, fur, feathers, honey, etc., (4) Agricultural Industries—flour, wine, alcohol, sugar, dried fruits, etc., (5) Agricultural Machinery and Buildings, (6) Agricultural Statistics and Rural Economy. The details of the exhibits are full of interest and the museum as a whole is worthy of the highest consideration. Few if any agricultural museums in the world, certainly none in our own country, are more complete or better designed to meet the purposes for which such a museum is intended. Much space is given to the collections of wheat, both the soft and hard varieties. The labels indicate where and by whom each sample was raised, production per hectare, and the value of the crop.

Maize or Indian corn stands next to wheat in value as an agricultural product of the Argentine. Then follow oats and linseed. Tobacco is already an important crop in some of the provinces, and peanuts now have a place in the agriculture of the country.

The increase in agricultural production during the last twenty-five years has been phenomenal. During this period the acreage under cultivation rose from less than five million to nearly twenty-five million hectares. The average area for the five years 1909–10 to 1913–14 in cereals and flax was 12,683,-085 hectares or more than thirty-one million acres. In 1917–18 there were produced 5,973,000 tons of wheat, 4,335,000 tons of maize, 1,100,000 tons of oats, and 568,000 tons of flaxseed.

In the forestry exhibit in the Agricultural Museum there are more than 750 varieties represented. Each specimen consists of a section of the entire trunk, one and one half meters long. At 80 cm. from the lower end the stem or trunk is cut to the center at right angles to its length, including one half the circumference. Then for 30 cm. there is

WORK OF LANDSCAPE ENGINEERS AT RIO DE JANEIRO

Rio de Janeiro, capital of Brazil, unlike Buenos Aires, is set within a magnificent semitropical forest. The celebrated Botanical Garden is filled with hosts of interesting plants from the warm countries, among which enormous bamboos and stately royal palms are the most striking. The South American municipalities have profited greatly from their employment of landscape engineers as well as botanists and horticulturists in laying out their gardens, thereby producing pleasing nature retreats as well as scientifically valuable collections a longitudinal section beyond which the terminal portion is cut on an angle or is beveled off. One half of each of these three surfaces is cut smooth or planed, the other half is polished. The appearance of the wood from the rough to the finished condition is thus well shown. The labels accompanying each specimen give the scientific and common names, the botanical family, the habitat, and its economic uses and value. On a small map attached to each specimen is indicated its distribution in the republic. Many valuable hard woods abound in the timbered regions; the number belonging to the Leguminosæ is very large. Quebracho colorado (*Schinopsis Balansæ*) supplies a very hard and exceedingly durable wood, besides yielding an abundance of excellent tannin, and both the wood and tannin are now important articles of commerce.

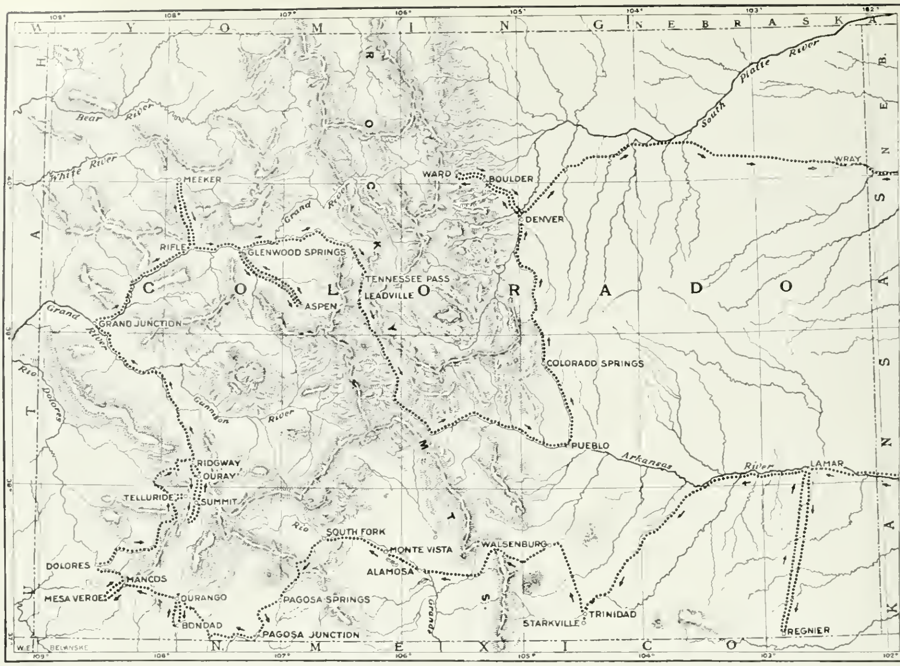
Across the avenue from the grounds of the Rural Society is the Zoölogical Garden which was first inaugurated by General Sarmiento in 1874. Fourteen years later the Garden became the property of the city. Under the direction of Seignior Clemente Onelli it has become the most artistic and beautiful garden of its kind in the world and now figures prominently among the delightful places of Buenos Aires for recreation and instruction. It is open from sunrise until sunset, and the annual attendance ranges from one and one half to two millions. Many kinds of trees and shrubs have been planted in this garden and the effort to develop beautiful scenes and vistas has been very successful. It is now well stocked with animals and birds, and Director Onelli has taken pains to surround the different animals with conditions and housings similar to those of their native countries.

Just beyond, at the corner of Santa Fe and Plaza Italia, is the Botanical Garden. This garden is a model in its way. It was planned and directed by Dr. Thays, and will stand as an everlasting monument to his knowledge as a scientist and skill as a landscape engineer. Begun in 1892, the grounds were opened to the public six years later, or in 1898. The appearance of the garden in 1910 was a revelation in plant growth and bespoke a good soil and adaptable climate and a skillful gardener.

Within its twenty-two acres have been assembled plants from all the countries of the world. Some of these are merely curious, like Palo Borracho (*Chorisia insignia*) and Ombu (*Phytolacca dioica*) and some are only decorative, but for the most part the plants and trees one sees here have an economic value or scientific interest. There are groups of medicinal plants, oleaginous species, and fiber plants; there are narcotic plants, and those valued for their perfume, and so on through all the uses of the vegetable kingdom. There are bits here and there that have been laid out as special gardens—a Roman garden of Pliny's time and a lovely miniature French garden are conspicuous examples. There are sections devoted to the typical plants of Argentina, of Europe and Asia, of Africa, North America, and Australia. Among those from Australia are eighty or more species of eucalyptus or gum trees. There are collections of palms and bamboos, of cacti, coniferous plants and grasses, and so on, amounting altogether to more than 3500 species. One stands amazed at the number and variety of plant families installed in so small an area without any evidence of overcrowding or lack of harmony in arrangement.

There are more than forty markets and market places in Buenos Aires. The great central produce market on the Riachuelo is an enormous three-story building covering several blocks. It is devoted chiefly to wool and hides and, it is said, is the largest market in the world. There are many meat and fruit markets and the hucksters and corner fruit stands are as common here as in the cities of the United States.

The roads beyond the city are usually very poor and country produce is still brought to market on great two-wheeled carts drawn by oxen. The people of Buenos Aires are excessively fond of flowers for home decoration and many flower markets have opened up in recent years. So great has this trade become that Buenos Aires has been called the City of Flowers



The expedition's route through Colorado.—Colorado may be divided into three main north and south belts, each covering approximately a third of the state. These are the High Plains on the east, the Rocky Mountain system traversing the middle, and the Colorado Plateau—a rough region of plateaus, desert valleys, and mesas—on the west. Starting from either side and traveling toward the central mountains one traverses successively the Upper Sonoran, Transition, Canadian, and Hudsonian life zones to the Arctic-alpine zone on the highest ranges. Between the higher ranges and extending as a central belt lie a series of high, open plateaus from twenty to fifty miles wide known as North, Middle, South, and San Luis "parks." The first three are occupied chiefly by Transition and Canadian zones and the last by Upper Sonoran and Transition. The northern and southern se tions of the state differ slightly in plant and animal association, although not in general zonation. By traveling parallel eastern and western routes lengthwise of the state, Dr. F. E. Lutz, in charge of the American Museum Expedition, visited representative areas of all major associations and topographic regions

An Entomologist in Colorado

From hot deserts, through forests, to the wild flowers and the snows of mountain tops.—Field study with special reference to the life zones of the state

By FRANK E. LUTZ

Associate Curator of Invertebrate Zoölogy, American Museum of Natural History

"WHERE does the West begin?" Thinking of the people, we might sincerely answer with the poem that was pinned on the wall of my hotel room in a little Colorado mountain town, and say that it was where the heart grows warmer and the hand clasp grows firmer. But where does the West begin in unemotional scientific discussion?

Years ago, when the West was young—nearly fifty years ago, in fact,—the Government, at Washington, published an elaborate geographical, geological, and biological survey of the territories west of the 100th meridian. Nature, too, seems to have accepted this meridian of round numbers as a convenient boundary line, for she has u ed it roughly as the limit of abundant rains on the plains. We, then, may say that we have really reached the West when we have crossed into Montana, Wyoming, Colorado, or New Mexico. Much short of that is East, except to those of us who learned to look at the sun setting back of the Appalachians as the veritable close of day.

How little do we know of the West, our

West! Much fun has recently been poked at the tourists who, cut off from spending their summers seeing the things that generations have looked at in Europe, have discovered Alps in their own country and architectural monuments of prehistoric Americans—some of the houses possibly made when Rome was in her infancy. But entomologists at least may not throw rocks of ridicule at tourists. We do well to search out the secrets of Central Africa and the wilds of South America, but, when we at the American Museum came to write an account of the geographic distribution of the insects of the West Indies, we found it necessary first to learn more of the insects of our own country, particularly of our West. Accordingly, two years ago, we sent an expedition to Arizona to study the fauna of mountains which are isolated by deserts just as the West Indies are mountains isolated by water. Last year we had an expedition to get samples of the fauna from here and there on the plains and the mountains of Colorado.[1]

Anyone who has traveled or even read good descriptions of regions other than his own, realizes that the plants and animals of one region may differ considerably from those of another. If the difference is great and is not merely the effect of environment (such as the differences between a swamp and a dry hill) the two regions are spoken of as belonging to different life zones, the term "zone" being a relic of the time when it was thought sufficient to speak of the animals of the Torrid Zone, Temperate zones, and Frigid zones. Florida is clearly not in the same "life zone" as New York, and the New York region is different from Labrador. Not so clearly, perhaps, but truly, the lowlying region of Long Island has a different set of animals and plants from that on the heights of the Adirondacks in the same state.

It is also to be noted that the high altitudes in one locality tend to have the same set of animals and plants as do the lower altitudes of more northern localities. Life zones are defined everywhere in accordance with variations in temperature and the distribution of the fauna may be further influenced by humidity. The life zones at the north and high on mountains are known as Boreal. In these there is, in general, sufficient humidity to support such life as the low temperatures permit, so that humidity is not so important as temperature. Below the Boreal is the so-called Transition zone, and the zones farther south or at still lower altitudes are called Austral. (See diagrammatic arrangement below[2].) In the Austral areas there is a great difference in humidity east and west of the 100th meridian. The rainfall west of this line is slight compared with evaporation; east of it the rainfall is abundant, so that the plants and animals of the same altitudes and temperatures east and west may differ more than those of different altitudes and temperatures either east or west; or, using the names which have been given to these subdivisions of the Austral areas, the Austroriparian, for example, differs more from the Lower Sonoran than the Lower Sonoran differs from the Upper Sonoran.

It was near Dodge City, Kansas, that we crossed the mystical 100th meridian and passed from the humid or Carolinian division of the eastern Austral to the dry Upper Sonoran division of the western Austral. Naturally the change in climate, plants, and animals is not abrupt, but even occasional glances out of the car window showed that we were getting into a different country. Near Dodge City the prairie becomes sandier and more humpy. The humps tend to be flattopped, somewhat mesa-like, and a sort of yucca is a common wayside plant in places.

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[1] We expect to follow this up by obtaining similar samples from other regions in which we hope to find not so much insects new to science (that is easy), but insects that will throw light on the relationships of one faunal region to another and how these relationships came about. In other words, we are engaged in a new survey of the territories west of the 100th meridian. A brief sketch of the trip to Colorado is given here as an illustration of this work, work in which we are admittedly getting merely small, scattered samples of the fauna, for the insects of June are widely different from those of September, and those obtained by one collector are far from the same as those obtained by another equally good collector who may, by reason of special interests, have even unconsciously adopted different collecting methods. Furthermore, as only those who have been on the ground can fully realize, the West is vast.

[2] Boreal { Arctic-alpine, Hudsonian, Canadian

	Arid *West of 100th meridian*	*Humid* *East of 100th meridian*
Transition	Transition	Alleghanian
Austral	Upper Sonoran	Carolinian
	Lower Sonoran	Austroriparian Gulf Strip

We reached Lamar on the third of June. It was cold and rainy and some of the inhabitants even asserted that it had snowed the day before. This southeastern corner of Colorado is the lowest part of the state but, while enthusiasm outruns fact when it maintains that Colorado begins where Mt. Washington (6290 feet) leaves off, Lamar has an altitude of 3600 feet.

It was too cold, rainy, and windy just then to do much insect collecting, but I picked up a few specimens among the cottonwoods that bordered the Arkansas River and left the next morning in an automobile stage for Springfield, the seat of Baca County. It took us more than five hours to cover the fifty miles of prairie between Lamar and Springfield. The vegetation, except along the few streams, is of the short-grass type, the kind that makes you wonder how so many cattle manage to thrive on it. For miles around, a conspicuous landmark is the relatively high Two Buttes (400 feet above the plains) and they were especially interesting that morning because they were surrounded by what seemed to be a beautiful lake, but which was really a mirage.

At Springfield I was lucky in catching a ride to Regnier in an antiquated but efficient Maxwell that was used by the mail carrier. I delivered mail to the boxes on my side of the road while prairie dogs sat bolt upright at their burrows, scolding, and the curious little owls that live in deserted "dog" burrows blinked at us. Ground squirrels, jack rabbits, and cottontails were also in evidence. "Bull bats"—a night hawk that flies like a bat and makes a noise like a bull—were sleeping on the tops of fence posts; blue quail scurried about, while bobolinks, meadow larks, and lark buntings made merry. At about supper time we arrived at Regnier, which is really the ranch of Dr. Felix Regnier, the post-office being in his kitchen.

One of the things in addition to Dr. Regnier's kind hospitality that attracted me to this region is the fact that the prairie is here cut up into numerous mesas and cañons, offering a wide range of local environments.[1] There are dry, level flats with low sparse vegetation, but gay with herbaceous flowers; there are cottonwoods and other luxuriant growths along the streams; the bowlder-strewn slopes of the mesas are covered with cacti; the "rim-rock" of the mesas is cedar-fringed; and most interesting of all, are the yuccas, cacti, and other drought-resisting vegetation of the rocky roofs of the mesas. In the cañon to the east I found a wide expanse of glistening sand teeming with predaceous wasps and tiger beetles, digging bees, and other interesting creatures, while in the cañon to the west was a veritable marsh.

After returning to Lamar I made short stops at Trinidad, Walsenburg, Alamosa, Monte Vista, and, on June 17, reached the village of South Fork. This is situated in an elbow of the Continental Divide at the junction of two tumbling mountain streams that give rise to the Rio Grande del Norte, the stream that eventually flows so sluggishly across the desert on the Mexican boundary. The elevation here is about 8200 feet, and the Canadian zone presses strongly on the thin tongue of Transition that extends up the river valley. The Transition is "said to be the foothill zone of Colorado, with its lower limit marked by the edge of the plains on the east and by the approach to desert conditions along the western bases of the mountains and plateaus."[2] The Canadian zone "occupies the middle slopes on the main ranges and extensive areas in the mountain parks and caps all of the higher western plateaus, thus including the larger part of the coniferous forests of the state. Broadly speaking, the Canadian zone is characterized in the mountains of Colorado by extensive forest belts of aspens (*Populus tremuloides*), lodgepole pines (*Pinus murrayana*), and the lower, heavier part of the Engelmann spruce belt."

At South Fork I secured the kind help of Mr. Million, forest ranger (formerly known as "Sourdough John," and a one-time acquaintance of Jesse James). We packed our camp and collecting outfit in his Dodge and started over the Continental Divide for Pagosa Springs. The first night we camped in the valley of the South Fork of the Rio Grande at about 8500 feet altitude. The chief trees on the hillsides were aspen, Douglas spruce, and Rocky Mountain yellow pine. In the valley were willow, narrow-leaf cottonwood, and blue spruce. The

[1] The Lamar-Regnier region is a part of the Great Plains Division of the Upper Sonoran zone.

[2] *North American Fauna*, No. 33. By Merritt Cary. United States Department of Agriculture, Washington, 1911.

UPPER SONORAN LIFE ZONE IN COLORADO

Climatic areas of somewhat similar temperature and rainfall harbor similar associations of plants and animals and so constitute more or less well-marked "life zones." Colorado, on account of its diversified topography and range of altitude, possesses a greatly varied flora and fauna, representing five out of the total of seven life zones found in North America. These three pictures, taken near Regnier in the southeastern corner of Colorado, illustrate the characteristic appearance of the so-called Upper Sonoran zone which includes all the basal plain on both sides of the Colorado mountain ranges or nearly one half the total area of the state. From the plains rise the rocky slopes of the mesa (photograph at top), with its juniper-fringed "rim-rock" (middle photograph), and flat desert roof bearing yuccas and cacti (lowest photograph). The Upper Sonoran is an arid zone, extending between the Great Plains on the east and the Great Basin of Utah and Nevada on the west. Associated with its drought-resisting vegetation are such small mammals as spermophiles, prairie dogs, and several species of mice and rats, and a varied desert reptile fauna. Junipers (*Juniperus monosperma* and *J. scopulorum*) are characteristic, and piñons also grow along the foothills and on the rough country of the south

OTHER VIEWS IN THE COLORADO UPPER SONORAN

The western slopes of the Colorado Rockies differ from the high plains of the east in a more arid climate and more deeply eroded surface. Sagebrush (top and bottom photographs from Mesa Verde and Bondad, respectively), sheltering cottontails and jack rabbits, is the characteristic growth of this region, although along the streams are found cottonwoods and willows. The Upper Sonoran zone, in spite of this aridity, is the agricultural land of Colorado and wherever it can be irrigated, it supports valuable grain, beet, potato, and fruit crops. Over the uncultivated areas range great herds of cattle, feeding on the sparse grass. The Mesa Verde photograph shows typical wild-flower gardens of the Upper Sonoran, and the middle photograph from Wray (northeastern Colorado) a type of sand-hill country like that of Nebraska to the north

THE BEGINNING OF THE FOREST—TRANSITION ZONE

The Transition zone on the foothills covers an area equal to only about one fourth of the state. The Transition country is for the most part too rough and broken for agriculture. The intimate relation between crop zones and natural life zones is marked in Colorado so that a biological survey is prerequisite to intelligent agricultural projects. The upper scene, at Pagosa Springs (southwestern Colorado), shows the meeting of Upper Sonoran with the Transition above it; the bottom photograph is from Electric Lake, north of Durango, where the Transition shades into the Canadian still higher; the middle picture illustrates pure Transition near Walsenburg, among the eastern foothills, with cacti, junipers, piñons, and yellow pine valley floor was rather wide and more or less boggy, bright with great masses of blue iris and yellow *Thermopsis montana*.

We may use trees as illustrations of the conditions at this extremely interesting location, partly because their distribution has been very thoroughly worked out and partly because they are familiar to most of us. The thousand or more species of insects living there have not yet been identified so that we do not know what their evidence will be, but it is clear that this evidence must be carefully collected and just as carefully used, for the creatures of the slope on which we were camped have distributional ranges quite different from those on the valley floor or those on the opposite slope. Furthermore, all about there was a tension, the Transition and the Canadian each straining for an increase of its respective area.

We next went to a camp at the point where Pass Creek joins the South Fork of the Rio Grande at an elevation of 9425 feet. It was fairly distinct Canadian zone with aspen, balsam fir (*Abies lasiocarpa*), blue spruce (*Picea parryana*), and mountain juniper (*Juniperus siperica*). Rocky slopes, narrow ravines, and extensive open "parks" scored with elk hoofs offered a variety of habitats for our collecting. Although past the middle of June, the nights were cold and the ground was covered with frost in the mornings. Our evening fire was the meeting place of the forest rangers who were working in the vicinity. Many tales of the mountains were told. The rangers were of the opinion that the "yellow" black bears are getting more plentiful, that beaver are increasing, that sheep are driving out the elk.

The road up Pass Creek over the Continental Divide and down Wolf Creek had been cleared of snow and was, for the most part, dry. In many places there is space enough between straight up and straight down for only one vehicle.

The roof of the continent is here 10,800 feet high. I chased butterflies over snowbanks and "Sourdough" amused himself picking flowers with one hand while at the same time he made snowballs with the other. The pools of melted snow were musical with frogs. Flies, more abundant than bees, were pollinating the hundreds of white and yellow flowers. We were here at the upper edge of Hudsonian, and Arctic-alpine was in sight on the mountain crests around the pass.

Our next camp was near the foot of the mountains on the Pacific slope for the water of Wolf Creek eventually reaches the Bay of California. Extremes in camping met there that night. On one side of us was a retired business man and his family with an expensive car and two auto tents; on the other was an old-timer who was on his way in a prairie schooner to work in Kansas harvest fields. During the night an Indian came thundering into the camp, not on a pony and with a whoop, but in a noisy Overland. The next day we reached Pagosa Springs, where I was sorry to part company with Mr. Million and his stories of wild Colorado from the time of Leadville, Cripple Creek, and Creede to the present.

At Pagosa I collected in Transition by going north and in Upper Sonoran by going south. Although differences in latitude, when great enough, determine distributional areas, the factor here was a difference in altitude which merely happened to coincide with north and south. The same was true at the next stop, Durango, and south of it, at Bondad, the conditions were quite similar to those over large areas of the Upper Sonoran in New Mexico, sagebrush plains with scrub oaks, juniper, and piñon on the slopes.

Through the kindness of Messrs. French and Clay I spent nearly a week at a lake north of Durango where I collected through an altitude range of from about 8000 to about 10,500 feet, Transition to Hudsonian. It occurred to me after I had left that I had not wet a line although the guest of a fishing club nor had I touched an artificial "fly"—the natural flies were so interesting.

At Mesa Verde I was joined by Mr. Pearce Bailey, Jr., a volunteer assistant. Mesa Verde is developed and protected as a national park under the Department of the Interior because of the cliff-dwellers' ruins, but fortunately this protection extends to the plants and animals. Before going there I had met the superintendent who regretted that I had no apparatus for taking color-photographs of his "flower gardens." When I had seen them my regret was as keen as his; luscious blue lupines, silvery Mariposa lilies (*Calochortus*), beardtongues (*Pentstemon coloradoensis* and *comarrheus*), mallows (*Sphæralcea coccinea*) and sunflowers (*Helianthus petiolaris*) set in the gray

AS WE CLIMB THE COLORADO MOUNTAINS

Between Transition and Canadian zones.—The Canadian life zone, such as is typical of central and southern Canada, covers the middle altitudes of the Colorado mountain ranges. Where this photograph was taken near the South Fork of the Rio Grande in the San Juan Mountains, the Canadian and the Transition zones contended for supremacy, aspens, yellow pines, and spruces mingling on the mountain-sides

Higher in Typical Canadian.—The forests of the Canadian zone are chiefly occupied by aspens and Engelmann spruces, the latter extending down from the next higher or Hudsonian zone. The aspens grow together in dense thickets, their light green foliage standing out clearly among the dark conifers. This picture illustrates typical Canadian growth near Telluride, west of the Continental Divide

Still Higher in Upper Canadian.—Most of the Canadian zone in Colorado is forest covered. The aspen is associated in the northern two thirds of the state with lodgepole pine (shown here) and in the south with white fir. Wild elderberries, blueberries, and currants flourish, and the columbine, the state flower, blooms abundantly. Canada lynx, western fox, and black bear range into the adjoining zones on either side

WE CLIMB STILL HIGHER

From the forested Canadian zone into the Hudsonian to timber line

The Hudsonian zone as represented in Colorado is relatively narrow—about 1000 feet in vertical width. The upper two photographs were taken along Pass Creek in the Sangre de Cristo Mountains. The bottom comes from a higher altitude still, about 10,800 feet, near Wolf Creek Pass on the Continental Divide. A dark belt of Engelmann spruces and balsam firs winds in and out, marking with its clear-cut edge the limit of tree growth. The expedition collected butterflies over snowbanks, and the pools of melted snow were musical with frogs

Very bare and bleak at the top.—The bleak wastes of the Arctic-alpine zone extend upward from about 11,000 feet elevation. Snow lies on the ground for the greater part or all of the year, but wherever it melts or blows away during the summer, many brilliant flowers enliven alpine meadows. These flowers are near relatives or actual representatives of species growing along the shores of the Arctic Ocean. Grizzly bears, mountain sheep, coyotes, western foxes, martens, porcupines, and snowshoe rabbits find their way here, and the white-tailed ptarmigan, pipits, and brown-capped rosy finches breed nowhere else. The photographs were taken near Ouray, Colorado

The dwarfed willow is the only tree of the Arctic-alpine zone. It abounds chiefly in bogs and gulches, and even after many summers stands only a few inches high

AT MESA VERDE NATIONAL PARK

The Spruce Tree Cliff Ruins (lower photograph) are one of a remarkable series of about 300 prehistoric cliff dwellings at Mesa Verde. This house, possibly made when Rome was in her infancy, contains 114 rooms and 8 ceremonial chambers, and must have sheltered between 300 and 400 inhabitants. The vanished race of unknown antiquity which inhabited these high fortresses found fertile fields among the rough Upper Sonoran valleys as have their white successors at the present time.

Mesa Verde National Park, in Montezuma County, southwestern Colorado, is typical of the juniper and piñon belt of the Upper Sonoran life zone, with a scattering of Douglas spruce coming down from the Transition sage with a background of dark green cedars. and piñons. Insect collecting was fine, and man at Mesa Verde was as satisfactory as nature. Visitors are provided with clean, comfortable, board-floor tents; excellent meals are served; and the broad veranda of the museum of cliff-dweller culture affords a fine view of cañons and mesas. The region is Upper Sonoran with a touch of Transition.

In this first month I had obtained samples of the fauna of southern Colorado from Kansas to Utah. Now we turned north. Leaving Mancos in the hot Upper Sonoran about noon we lunched at Dolores. Along here the railway tracks were banked with wild roses in full bloom. Wild geraniums, large red lilies, Indian paintbrush, and many plants I did not know, were a riot of color. By the time we reached Stoner Creek spruces were fairly common. After we got well into the spruces the roses dropped out. Above Rico the cañon narrows very much. Then we pulled out of it and by four o'clock our train was passing through high Alpine meadows with snow on the hills all about us. At Trout Lake the peaks seemed to be right at hand—snow and bare rocks, so bare that one of our train mates said, "It looks like they had just been made." Then we started down and it seemed almost as though we were sliding down a spiral stairway, the road was so crooked and the descent so rapid. We dropped 1700 feet to Vance Junction and then our engine went to the other end of the train and pulled us up 640 feet to Telluride.

Telluride has an extremely beautiful view up the main street, with a waterfall tumbling off the mountain like a huge city fountain. That evening I tried to buy a post card of this but found nothing but pictures of mines, smelters, and business blocks. The town is nearly 9000 feet above sea level. Wild roses and blue foxgloves were in full bloom at the starting of the trail. At about 9800 feet we were among aspens and spruces. I kept on slowly, collecting along the way, until 11,750 feet altitude was reached. Here I was right among—and on—snow banks of the Arctic-alpine. Between the masses of snow were masses of flowers similar to those at the head of the Rio Grande. Willows at the edge of the snow had catkins but no leaves; ten feet away the same species was in leaf and the catkins fully seeded. After washing down a belated luncheon with snow-water, I walked back on the trail, getting many specimens along the way and keeping an eye on the barometer in order to have the altitude notes as accurate as possible.

The sharp contrasts to be found in Colorado are shown by the fact that the next morning we were collecting Upper Sonoran things at Ridgway in sagebrush, cactus (with red and also yellow flowers), pink foxglove, yellow asters—also heat and horse-flies. The last two were torturing, but the flowers were swarming with entomological specimens and the hot sand was fairly alive with tiger beetles and digging wasps and bees. That evening we were wearing sweaters in Ouray, where we were joined by another volunteer assistant, Mr. Herbert F. Schwarz. Here we worked for several days, chiefly in the Canadian but getting well up into the Arctic-alpine also.

On one of these days we accompanied Mr. Watkins, forest ranger for Ouray, on one of his regular trips. We first took Horse-thief Trail straight up the side of one of the cliffs that hem the town in—straight, that is, in the same way that a sailboat goes straight when sailing into the wind. My horse was a "trail-edger," a trait that avoids the danger of bruising one's legs against the rocks on one side and adds to the realization that it is a long way to the bottom on the other side.

Finally we got to what seemed to be the top of things. We were above timber line on a grassy ridge filled with a great variety of Arctic-alpine flowers. Thinking that the trail would be easy from there, I asked Mr. Watkins to lead my horse behind his while I walked, collecting along the way. I soon changed my mind, for, around a corner, was more up grade and above 10,000 feet a low-altitude lung does not pump enough air to permit of fast walking up hill.

I then accustomed my horse to the net and collected from horseback pretty much as though I were playing polo. I soon stopped this for we began to go along the tops of ridges where the flowers were too close to the ground to be easily reached. Then the weather changed and it began to rain and blow. Rain (almost hail) and wind, combined with altitudes ranging from 10,000 to 13,000 feet, make it bitterly cold in the latitude of Colorado. It occurred to

IN THE COLORADO ROCKIES

On their way to pasture above timber line
Old charcoal ovens at Tennessee Pass—enemies of the forest which have been vanquished by conservation
The expedition, of the summer of 1919, representing the department of entomology of the American Museum, collecting on the Continental Divide, at 10,800 feet elevation

me to describe Colorado as "sagebrush and sunshine, spruce and showers," only we were above the spruces and I did not call what we were having a "shower."

Two days later at Grand Junction we were in the Upper Sonoran life zone again, this time the extension from the Utah deserts, where it was as hot as it had been cold on the American Flats. From there we went to Rifle and then to Meeker where so many big-game parties outfit. The Upper Sonoran at the latter place is a southern extension of that in Wyoming. We found insect, or "little-game," hunting in this northwestern corner of Colorado as good as the "big-game" sort is said to be and I venture to say that we got more trophies.

Glenwood Springs was our next stop, chiefly for the sake of getting a sample of the Canadian and Hudsonian zones on the western side of the Continental Divide at Aspen to compare with the same zones on the Divide at Tennessee Pass and on the eastern side at Leadville. I wish space permitted to tell of the almost neglected beauties, grand and in miniature, of the Aspen country; of the genial Mr. Maupin and his equally genial partner at Tennessee Pass where they divert water from the Pacific slope to pan gold and then sell the used water to farmers far down on the Atlantic slope; of the splendid lodgepole pine forests there, and our experiences camping in a forest ranger's cabin; of Leadville itself with sagebrush that is not Sonoran; and of the mountains near Leadville, including Massive and Elbert, the highest east of the Pacific states. But I must hurry from Leadville in the story, as we did in the journey, through Colorado Springs and Denver, with its most successful museum of natural history, to Boulder.

Here we had the pleasure of associating with Prof. T. D. A. Cockerell, of the University of Colorado, probably the most active student of natural history in the United States, a man who, to mention only one phase of his work, has described more than three thousand new species or varieties, not only of insects but of plants, mollusks, and other forms of life. Boulder itself has one of the best locations for the study of distribution that I have ever seen. Toward the east the plains extend until they are lost to sight by the earth's curvature; on the west the mountains rise like a wall to heights only a little less than Elbert and Massive, and most of that mountain land is assured to posterity because it is held either by the Department of Agriculture as national forests or by the Department of the Interior as the Rocky Mountain National Park. Professor Cockerell took me to White Rock in the Upper Sonoran plains where there is an island of even more southern flora and fauna; in the mountains we went to the Hudsonian about Long Lake near Ward and could easily have reached the Arctic-alpine if we had wished.

Our next and last collecting place was at Wray on the eastern border of the state. Here we were almost due north of our starting place, Regnier, and in the same broad belt of Upper Sonoran. The country was of the Nebraska sand-hill and prairie type. Contrasts were sharp between the very arid, wind-blown sands, the semiarid prairie and the rich bottoms of the narrow gulches. For a part of the time here I had the good fortune to stay at the Boyes ranch, the house set in the cottonwoods of Dry Willow Creek (which is never dry) protected from the drying winds of summer and the fierce blasts of winter by the gulch's sides. Some of my best captures were made here and certainly the comparison of the fauna of the ravine with that of the prairie will not be the least interesting that will be made.

Comparing the insects of this region in the northeastern corner of Colorado with those of Regnier in the same "zone" but in the southeastern corner will not be so easy, since the collecting in one place was done in late August and in the other in early June. But doubtless a way will be found and we have also the material from the Sonoran in the southwestern corner at Mesa Verde and the northwestern at Meeker, both separated from these by the Continental Divide. We have also material from many places in the Transition, Canadian, Hudsonian, and Arctic-alpine. There are more than 23,000 specimens, probably representing at least 2000 different species, or nearly half as many species of insects as there are of mammals in the whole world, and yet, when one realizes the large size and the still greater complexity of Colorado, together with its insect fauna of at least 15,000 species, one must confess that our expedition collected only samples.

The People Always at Attention

SO long as private capital is on the continual search for private privilege by which it may grow faster than under normal conditions, and so long as the lawmakers of our country are more or less dependent for their legislative election on local votes from this private capital and its friends, just so long will it surely follow that all the rest of the country at any given moment must be in arms to protect public rights. All the millions of us might as well gird on the armor for constant vigilance.

We can but wonder who is responsible for the final form of the Water Power Bill, which includes the national parks. In itself the bill is good and has been before Congress for a decade. The water power on public lands such as the national forest reserves no doubt should be made available for local capital under certain necessary restrictions. But nothing should be allowed to interfere with the historic national parks and monuments. They have been set aside by Congress with the express purpose of keeping them in an unchanged state of nature for the American people. They are the people's museums of the original American wilderness. The various falls, river basins, and lakes are among their greatest assets, and no way could be found to destroy them more effectively than to encroach upon these waterways. Congress could not have realized that passage of the Water Power Bill meant abandonment of its own creations which it has cared for during nearly half a century.

The bill creates a commission of three persons, the secretaries of War, Interior, and Agriculture, respectively, with power to "grant licenses for the *construction of dams, power houses, and other necessary or convenient structures on public lands and reservations.*" It was thrown into conference six months ago and a compromise bill came before Congress just a few days prior to its recent adjournment; this was passed hurriedly and sent to the President, who signed it.

The unhappy inclusion of the national parks in the final form was not brought to the attention of the members of the National Parks Association until the day of adjournment. As they say, the "situation is unthinkable." Each citizen in the United States who is interested in the conservation of the scenic grandeur of which we are so proud, and in the rights of the American people, has a plain duty before him: to suggest to the representatives of the law in Washington from his state that the first work of the new session of Congress should be to amend the Water Power Bill.

We shall be the more willing and ready to act if we realize that such cases are continually to be expected, that it is just our simple duty, plain before us, to keep a grip on affairs so that all such matters which slip through Congress a part or all of the way toward becoming laws may be counteracted. The opinion of every voter is bound to have influence. The more forcefully he expresses his opinion the more effect it will have.

Let us at once send for the recent *News Bulletins* of the National Parks Association (No. 1512 H Street, N. W., Washington, D. C.) and get acquainted with the facts in detail. Also let us write to the same address for the first number of *The Nation's Parks,* a magazine just inaugurated to meet the crisis at hand. It is frankly admitted that the time is one of peril and our help is asked.

Surely we will not see dams and power houses, under the Water Power Bill, constructed in connection with Yosemite or Yellowstone falls. We will not allow a bill to pass Congress which will authorize use of Falls River Basin in Yellowstone Park for irrigation purposes! Such a bill comes up again before the December Legislature. We will not allow Montana ranchmen to dam the beautiful Yellowstone Lake in Yellowstone National Park.

All national reservations, both the so-called "national parks" and "national forests," should serve for the recreation of the people. The relatively very small "national parks" are for recreation only, each having some notable scenic feature which justifies its withdrawal from industrial development. The very extensive "national forests," which serve for recreation, safeguarding the timber, and equalizing the water flow, should also be open to local use of their water power and other resources, under permit and with scientific supervision.

The Congressmen are confused between these two policies. They know what the western commercial and industrial interests want; they are not so sure what the people want. Let us tell them what we want. Let us stand behind public rights.

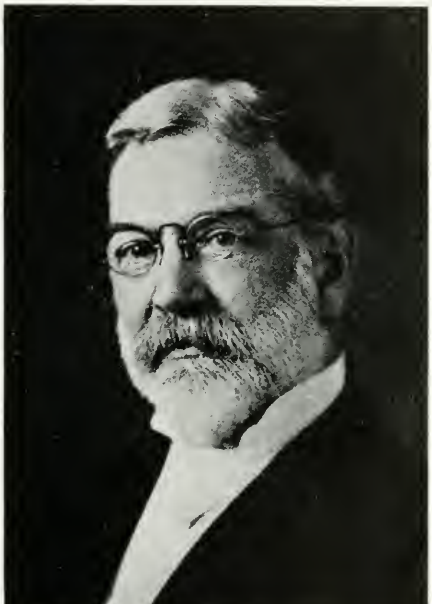
William Dutcher—In Memoriam

A leading pioneer in the cause of wild life protection in America

By T. GILBERT PEARSON

Secretary, National Association of Audubon Societies, New York City

At his home in Chevy Chase, Maryland, William Dutcher, president of the National Association of Audubon Societies, died on July 1, 1920, in the seventy-fifth year of his age. Those who knew him only in connection with his work for bird protection will experience the realization of profound loss that always comes when a great leader has fallen. To those who were intimately associated with him during the active years of his life, the passing of an unusually inspiring and kindly indulgent friend will be of life-long sorrow and regret.



Mr. William Dutcher, 1846–1920, president of the National Association of Audubon Societies for the Protection of Wild Birds and Animals since its incorporation in 1905

William Dutcher will go down in history as one of the leading pioneers in the cause of wild life protection in America, and as the man who, more than any other, was responsible for the establishment of the National Association of Audubon Societies for the Protection of Wild Birds and Animals. Dutcher did not originate the Audubon Society. This was done by George Bird Grinnell, in 1886. Neither did he originate the Committee on Bird Protection of the American Ornithologists' Union. This was started at the suggestion of William Brewster, in 1884. These two influences dealing with the lives and fortunes of wild birds, the one emphasizing the scientific and technical, the other the popular and sentimental, were drawn together by the force of Dutcher's personality and in the end were combined into the National Association, of which by unanimous acclaim he has from the beginning been president.

In his younger days Dutcher's tastes led him into activities the experiences of which were destined to form a basis from which his later work was carried on with such rare intelligence and wide perspective. For many years he was an enthusiastic sportsman and made at least two trips annually to Long Island for the purpose of shooting ducks, geese, and shore birds. It is recorded that on one occasion, while in a blind with a bayman, he shot a bird that even the experienced local hunter could not name for him. He brought it home, secured a work on ornithology, and upon investigation found that he had taken a specimen of the Wilson's plover. This led him to ascertain the correct names of other birds that he shot. His nature was such that when his attention was once drawn to a subject that appealed to him, his interest became intense. It was, therefore, but natural that when once he began to study birds he was soon a most ardent student of ornithology.

He stopped shooting for sport and began to collect specimens. During the years that followed he wrote and published many papers on the birds of Long Island. His private collection of about two thousand birdskins he later donated to the American Museum of Natural History.

When along in the eighties the killing of herons, gulls, and other birds for their feathers had reached its height in this country, Dutcher was much stirred by the articles published by Dr. Grinnell and the information on the plumage traffic brought to light by the Bird Protection Committee of the American Ornithologists' Union. Dutcher, although not chairman of this committee at first, was very much interested in its work, and when in 1900 Abbott H. Thayer, the portrait painter, collected and placed in his hands $1400 for the protection of sea birds along the North Atlantic Coast, it may be said that William Dutcher's specific work for bird protection had begun. He visited the coast of Maine, located various breeding colonies of gulls, terns, and other water birds, and secured wardens to protect them during the nesting season.

In April, 1902, while chairman of this committee, he was also made chairman of the National Committee of Audubon Societies, which that year came into permanent organization. In January, 1905, at the suggestion of Albert Wilcox, of New York City, there was incorporated from this National Committee, the National Association of Audubon Societies. For the six years that followed, Dutcher was the Association's president and chief inspiration. He was tireless in inaugurating and pushing campaigns to secure state adoption of the "A. O. U. Model Law," later more generally known as the "Audubon Law," for the protection of nongame birds. He came to abhor millinery traffic in feathers of wild birds with all the might of his intense nature, and by pen and voice he sent his ringing protests through the length and breadth of the land. Under his powerful and convincing teachings thoughtful people in every section of the country were attracted and drawn to the cause of bird protection.

William Dutcher was a man of handsome physique and with a personality that drew men to him in a most unusual manner. There are many engaged in conservation work today who will recall that their first incentive to enlist in this cause came as the result of a talk with, or a letter from, this enthusiastic leader of bird protection.

On October 19, 1910, while at his home in Plainfield, New Jersey, he was stricken with paralysis, which rendered him entirely incapable of speech. For nearly ten years he lived in this most helpless and distressing condition. During most of this time his mind appeared to be clear, and he took the greatest interest in all the Association's developing activities, and would show the keenest delight when word reached him of any triumph for the cause of bird protection.

He is survived by his wife and their only son, Colonel Basil Dutcher, of the United States Medical Corps.

On July 6, 1920, he was laid to rest in Hillside Cemetery, Plainfield, New Jersey. It was a beautiful summer afternoon, and some of those who were present noted that during the last moments of the service about the grave, a robin in a grove near by sang with great power and clearness. Its cheerful notes were truly characteristic of William Dutcher's attitude during his long period of helplessness, and seemed also to speak of the joys of the future life toward which, with unwavering faith, his eyes had ever turned.

Photograph by Alvin R. Cahn

The Silver-winged Sea Birds

Observations on habits made while photographing the breeding birds of the Louisiana Gulf Coast [1]

By ALFRED M. BAILEY

With the Biological Survey of Alaska; formerly a member of the scientific staff of the Louisiana State Museum

IN days gone by the first coming of the hosts of terns and sea gulls from their southern winter homes to their breeding grounds along the Gulf and Atlantic coasts was eagerly awaited, and the news was heralded far and wide. Boat after boat, with its load of gunners, headed for the favorite feeding places, and the birds were greeted with such a murderous onslaught that several species of these graceful creatures were virtually exterminated. Times have changed since then and wise methods of conservation prevail. Our national government is now supervising its natural resources, and, with state coöperation, there is little to fear as to the outcome; but state coöperation is a necessity.

Along the Louisiana coast are some of the greatest bird colonies of today, rarely disturbed by poachers and regularly patrolled by state wardens. Thousands of terns and gulls breed along the marshes and off-lying shell keys, while the flash of a multitude of wings against the blue of sky and water is a familiar sight. The greatest colonies of nesting sea birds are to be found from the mouth of the Mississippi River eastward to the border of the state of Mississippi. Five species of terns and the laughing gull are commonly found.

The royal and Cabot terns are the most fearless of all, and the most numerous. They nest together in great flocks, each species keeping more or less apart, but individuals of each are usually found in the colony of the other. The courtship antics are similar in the two species. The birds pair off and soar together, one bird closely following the other in every movement. They sail without apparent wing movement, and so closely do they swing together and keep their interval, that the flight seems mechanical. The eggs of all the terns breeding on the shell keys are deposited directly upon the ground. The royal and Cabot have one egg each, while the least and Caspian terns usually have two. So protectively colored are the eggs of most sea birds that great care must be taken by the observer when walking among them.

The birds when disturbed exhibit great concern, and clouds of them float overhead, calling out their displeasure. It is when the little downy babies first make their appearance, however, that the adults become most fearless. They will then allow an intruder to come to within a few feet of the nest before

[1] For additional data and pictures of the water birds of Louisiana, see NATURAL HISTORY, Vol. XIX, No. 1, 1919, and Vol. XX, No. 2, 1920.

Illustrations from photographs by the Author.

CABOT TERNS—PROTECTED RESIDENTS OF LOUISIANA'S SHELL KEYS

Large colonies of nesting sea birds are to be found on the salt marshes and shell keys along the Louisiana coast where nation and state give them protection from poachers. Of the five species of terns the Cabots (*Sterna sandvicensis acuflavida*) are the most numerous and fearless, nesting on the sunlit shell as remote as possible from human habitation

SO FAR AS KNOWN, THE FIRST PUBLISHED PORTRAITS OF LEAST TERNS

The least terns (*Sterna antillarum*), the smallest of our silver-winged sea birds, are now recuperating their numbers after barely escaping extermination. One colony studied on Freemason Keys, Louisiana, in the summer of 1919, included about one hundred adults with many fluffy youngsters. The latter crouched close to the shell and lay still at our approach instead of skimming away as do the young of some of the other species. Their parents, however, are the wildest of the terns and quickly desert the young at the approach of a human intruder. When alighting the least terns run some distance over the ground with wings gracefully extended

DOMESTIC INSTINCTS OF THE LEAST TERNS

So quickly does a tern mother rush the food into the young bird's gaping mouth that we were unable to get any photographs of the proceeding except in the case of the least terns. The favorite fare consists of the small fish and shrimps which abound in shore waters. In fishing, the terns hover in the air for a moment and then suddenly dart headlong on their prey, sometimes completely disappearing from view beneath the surface.

Their eggs are laid in a slight hollow in the shell on the ground and for a large part of the time are left to the warmth of the sun. Of the terns on the Louisiana coast, four species, the Cabot, royal, least, and Caspian, all except Forster's, nest in colonies on the shell keys they desert. The intense heat kills the chicks if they are not protected by the parent's outstretched wings, and it is quite usual to see the panting babies resting in the shade thus made. When they are approached, the masses of young birds scurry away like drifting sand, always attended by their screaming parents hovering overhead.

Small fish and shrimps are the main items of food, which are secured by diving. The adult birds dart from on high with the speed of an arrow, sometimes disappearing completely from sight, and rarely do they miss their aim. When feeding the young, the mother has an irritating way of standing off and teasing the baby, then suddenly rushing up and chucking the food into the gaping mouth. So quickly was this done that I could scarcely get a photograph. Indeed, I saw many chicks secure their midday meal, but I could not register the performance except with the least terns.

These little fellows, the smallest of our terns, were nearly exterminated along our coast, but are now regaining their lost foothold. I found a colony of about one hundred on Freemason Keys this last June, and ten fluffy babies were crouched here and there in the shade of wisps of salt grass. The adults of the least terns were more wild than those of other species and deserted the young while we were yet one hundred yards away, but they continually circled overhead, while the babies, as if profiting from previous experience, crouched close to the shell and refused to move even when in danger of being stepped on. We erected a blind, and within a few minutes the adults lost their fear and settled down to the waiting chicks. Not until then did we appreciate the numbers of little ones scattered around the colony. The ten babies we first noted multiplied to several times as many, and with old birds only ten feet away from us, we had ample opportunity to study them. When brooding, the parent birds fluff out nearly double their ordinary size, with wings hanging and tail above the primaries, and when alighting, they run over the shell with wings extended in the most graceful manner imaginable.

Paddling along the bank of some sheltered bay, one is continually flushing small flocks of a dozen or so Forster's terns from their secluded homes. They follow the boat a short way, then return to their domestic duties. They, too, are easy to study at their nests from a blind, although the couple of feet of muck and water about the nest do not offer all facilities for study.

The Caspian terns are rather rare along the coast, although we found several small colonies. The easternmost mud lump had a colony of about thirty pairs and each pair had two fresh eggs at the time of our visit. I am convinced that they are poor home makers, for they deposited their eggs close to the water's edge, directly upon the mud where they were soon incased in slime and some of them half buried. The birds wildly deserted their nests at our approach, and although I left my blind there overnight, they refused to pose for photographs. Young Caspians take to the water more readily than any of the other species. They have a plaintive call note which carries a great distance. The first time I heard this note I was mystified, and it took me more than an hour finally to determine its source—a young Caspian far out from land. The parent bird hovered overhead and guided the young back to shore as soon as danger seemed past. The Caspians do not appear willing to fight for their rights, for several turnstones were busily breaking tern eggs while the owners stood on a little bar near and watched with apparent indifference.

The beautiful laughing gulls are audacious birds, following closely after the boats to gather in scraps. They do not nest in colonies but pick out sheltered places under a mangrove bush or among the marsh grasses in which to build. They nest abundantly on all the mangrove islands, several thousands crowding on Battledore, but I never found nests within ten feet of one another. When the birds approach the nest, they have the habit of alighting far behind, and skulking through the grass until within sight of it, then standing motionless behind some obstruction, sometimes for half an hour. Mosquitoes seem to be particularly attentive to the photographer during this time, and as the slightest movement causes the gull to spring into the air, he can only take the punishment in silence.

Louisiana has her thousands of birds in many different colonies, and each colony is increasing and forming others. With continued protection, we may hope for that former abundance of avian life so characteristic of our coasts in the early days.

The Dead Eagles of Alaska Now Number 8356

In January, 1919, through the columns of *Bird-Lore*, the National Association of Audubon Societies first advised the public of the nefarious bounty law in Alaska, which provides for the payment of fifty cents for every American eagle killed in that territory, and in the May-June issue of the same year it gave an account of our letter to the Governor of Alaska urging the repeal of this law at the last session of the Alaska Legislature.

In turn others have voiced their opposition to the idea that Alaska should seek to exterminate these noble birds. The association has put in motion certain activities which we have reason to believe will, *before long*, result in the repeal of this law. In the meantime the slaughter of eagles goes on at the rate of two hundred a month.

The following letter, dated April 22, 1920, from the secretary of the Alaska Fish and Game Club, brings up somewhere near to date the available information regarding the slaughter of these birds:

My dear Mr. Pearson,

Complying with the request as stated in your letter of April 13, it is advised that the Territorial records show that since last reporting to you as of date December 6, 1918, bounty has been paid upon 3256 eagles or total of 8356 since the passage of the act and its taking effect.

A vast difference is noted in the numbers of this bird showing in southeastern and western Alaska and it is safe prediction that if the slaughter continues for a few years longer the species will become practically extinct in this country. The number upon which bounty has been paid does not cover all which have been destroyed, for it is agreed between hunters that many a bird which has been shot is not recovered. Various estimates have been made as to the proportion of those brought in for bounty to those destroyed ranging from 25 to 50 per cent. It is believed that out of every four shot, three are reported for bounty, the other is either lost in the woods or seriously wounded and subsequently dies.

It will be a pleasure to respond to any of your inquiries from time to time, so do not hesitate to command.

(Signed) C. D. Garfield,
Secretary, Alaska Fish and Game Club.

The National Association of Audubon Societies is collecting resolutions on this subject from various organizations to file with the Legislature of Alaska. All interested clubs and associations are invited to coöperate by sending such resolutions to No. 1974 Broadway, New York City.—T. Gilbert Pearson, Secretary, National Association of Audubon Societies.

A Bibliography of Fishes

The American Museum has already published two volumes of the *Bibliography of Fishes*—one in 1916 and one in 1917—which give an inquirer in this field a list of about 50,000 titles of books, reports, and pamphlets, dealing with a vast and complicated literature extending from the time of Linnæus down to the year 1914. Such a work was necessary, since it had become difficult and vastly time-consuming to learn what had already been done as a first step in increasing our knowledge. In point of fact, earlier lists of references were so faulty that he who wished to study any phase of fishes was often obliged to devote weeks, even month , of his time to "running down" references. Someone had, therefore, to attack the problem of gathering this vast literature in an accessible form and presenting it worthily to future workers. It may be said that the present volumes have been on the way for thirty years, and that for nearly a decade the American Museum of Natural History has had its shoulder to the wheel in completing this altruistic work. The first two volumes gave the names of authors and the lists of their writings: there remained to produce an index which would render the titles accessible, and it is this index volume which at present is nearly ready to put in the hands of the printer. It represents three years' work on the part of the editors, Prof. E. W. Gudger and Mr. Arthur Henn, with the coöperation of the writer, out of whose card index of references the present work has grown. The third volume will include index, titles of pre-Linnæan publications, lists of voyages and expeditions which concern fishes, anonymous publications, and the like. We may note that in the opinion of the expert bibliographer of the New York Public Library, the present work (which refers not only to fishes from the viewpoint of living and fossil forms, but to their anatomy, physiology, histology, embryology, parasites, messmates and diseases) will be the most complete bibliography of any large scientific subject, and that it will rank in completeness with the concordances of Shakespeare and of the Bible. It is to be recorded that during the preparation of the index volume, the Museum lost through death the services of the well-known ichthyologist, Dr. C. R. Eastman.—Bashford Dean, Honorary Curator of Ichthyology, American Museum.

Notes

Major General William Crawford Gorgas, retired, surgeon general of the United States army during the four years of the World War, died in London on July 1, while en route to Africa to continue his fight against yellow fever. General Gorgas, born in 1854 in Mobile, Alabama, was the son of William Gorgas, a West Pointer and chief of ordnance of the Confederate army. He received his medical education at Bellevue Hospital Medical College (New York University), New York City. His fame as a physician rests primarily on his successful sanitary campaign against yellow fever, a work which he began in Havana in 1901 immediately after the discovery that the disease is transmitted by mosquitoes. During his lifetime General Gorgas was widely honored by universities and scientific societies and was knighted by King George of England shortly before his death.

The following official telegram was received from California, August 4. It would give pleasure to the American Museum if its publication here might result in an increased support in membership for the work of the League.

To the Editor of Natural History:

Save the Redwoods League receiving enthusiastic support throughout the United States. Object is to preserve by purchase or donation representative tracts of *Sequoia sempervirens* in primitive state. Cutting is already halted in several important tracts. League hopes to save a redwood national park, and a state park is urged along the state highway. In Mendocino, Humboldt, and Del Norte counties a redwood survey is projected to determine available areas. Smaller tracts on the highway will be preserved by establishment of memorial groves by organizations and individuals. Campaign of publicity for members and funds now going on. Membership increasing daily, over 3000 enrolled. All interested in preserving these magnificent and unique trees are invited to join the league and to use influence to secure other support from individuals and organizations. Annual membership fee is two dollars payable to R. G. Sproul, secretary-treasurer, 430 Library Building, University of California, Berkeley. Patron's fee is five hundred dollars.

(Signed) R. G. Sproul,
Secretary of the Save the Redwoods League.

Dr. James R. Angell, chairman of the National Research Council and professor of psychology in the University of Chicago, has been elected president of the Carnegie Corporation of New York.

The following engrossed felicitations have been presented to the Trustees of the Metropolitan Museum of Art, New York City, in recognition of the celebration of the fiftieth anniversary of that institution:

The Trustees of the American Museum of Natural History desire to extend to their fellow Trustees of the Metropolitan Museum of Art their cordial and fraternal felicitations on the occasion of the Golden Jubilee of the Metropolitan Museum of Art. This marks the completion of the first fifty years of idealism in direction and of unexampled generosity in contribution which in the brief period of a half century has placed our sister institution the foremost in America and among the foremost in the world. We look forward with confidence to the new half century of advance in all that art and beauty mean in their influence on American life, culture, and civilization.

The noted American hunter and sportsman, Mr. Walter Winans, died suddenly in London on August 12 in his sixty-eighth year. Mr. Winans, although spending most of his life abroad, was a true American and a friend of the American Museum which he enriched with a number of specimens. He was a noted marksman, winning the revolver championship twelve consecutive times in England, the dueling pistol championship in Paris in 1909, and the world's championship with the hunting rifle at the Olympic Games in 1908 as a member of the American team. His gifts to the American Museum were the result of his skill with the rifle. The most noteworthy of these are the group of wild boars from the Black Forest, awaiting a place in the hall devoted to the life of Europe and Asia, and a series of pheasants, illustrating various phases in albinism. His last gift was a specimen of the Chillingham wild cattle, regarded as survivors of the native British oxen.

The largest and most mysterious land animal known in the world today has been named *Baluchitherium osborni* by its discoverer, C. Forster Cooper, now curator in the University Museum of Zoölogy, Cambridge, England. The animal is like neither an elephant, nor a rhinoceros, nor a titanothere, nor a moropus. Mr. Cooper writes that the ankle bone is certainly that of a perissodactyl and seems nearer to the rhinoceros than anything else. A giant primitive rhinoceros tooth, ten centimeters across, has been found, which indicates the presence of rhinoceroses of gigantic size in the Bugti beds of Baluchistan in Oligocene times, which was a strange faunal period.

The *Baluchitherium*, if a rhinoceros, certainly had a very long neck, more like that of a gigantic giraffe than that of a horse. Two of the anterior vertebræ of this monster have recently been received in the American Museum and have been compared with all our large land animals, living and extinct, with no result. These neck vertebræ dwarf those of all the largest land animals.

The Bugti beds, which have been explored by Cooper and by Pilgrim, also yield a hornless rhinoceros, *Paraceratherium*, in which the lower incisor teeth are turned downward; a hippopotamus that is typical except that it lacks front teeth; and a beautiful anthracothere called *Gelasmodon*. This gives us a glimpse into the still unknown mammalian life of southwest India.

Dr. Clark Wissler, curator of anthropology in the American Museum, will be absent for one year beginning June 1. Dr. Wissler spent the month of June visiting the Pueblo ruin at Aztec, New Mexico, after which he went to Hawaii for two months where he will represent the American Museum at the Pan-Pacific Congress in August. Following this, Dr. Wissler will assume his duties as chairman of the Division of Anthropology and Psychology of the National Research Council in Washington.

Dr. Wissler writes that while at Aztec he witnessed the excavation of the most remarkable room so far found in any cliff dwelling—"a sealed-up room in perfect condition. The interior is plastered and painted in a brilliant white with dull red side borders and a running series of triangular designs. No room approaching this in beauty and perfection has ever been discovered in America. It is the one great stroke of our work here. There are several adjoining rooms that seem to have some relation to this, but it will be some time before they can be dug out.

"What we have is obviously the holiest shrine of these prehistoric people. There is not much in it, all the sacred objects having been removed from the altar. But on the ceiling beams are imprints of hands made by rubbing white paint on the palms and fingers and then pressing down upon the beams. Several strands of beautifully made rope hang from the ceiling, presumably for the support of hanging objects. On the floor were a large number of nicely cut stone slabs. This room is one more suggestion that the people who lived in the cliff houses were the founders of the culture at Aztec and Bonita. Thus we may assume that the people who lived in Aztec were forerunners of the living Pueblo Indians in the same way that the cliff dwellers preceded them."

The genesis of the peculiar sacred rooms or kivas of the cliff dwellers, as pointed out by Dr. J. Walter Fewkes, chief of the Bureau of American Ethnology, in an address before the Anthropological Society of Washington, has been discovered through excavations in the Mesa Verde National Park, Colorado. This type of room is prehistoric and now extinct, but the record of its evolution is still to be found within the limits of Mesa Verde. The most primitive prototype of the kiva is an earth lodge fitted with bins made of stone slabs set on edge. Between this rude lodge and the fine multiple unit type of kiva of regular horizontal masonry are to be found a complete series of lodges in ascending stages of development.

The employment of monkeys as coconut pickers has often been described. The former curator of museums at Sarawak, Borneo, affirms that the Bornean natives train *Macacus nemestrinus* for this work. The monkey, tied to a cord, climbs a coconut tree, and twists off the ripe nuts in response to shouts from his master below. An authority in Sumatra confirms this account, adding the fact that the monkeys have considerable commercial value as laborers. Trained animals bring from $8 to $20 a head. The monkeys used are large and usually remain very savage.

The Natural History of South Africa, by F. W. Fitzsimons, director of the Port Elizabeth Museum, is addressed to the general public of South Africa, including the school children. The work, two of the four volumes of which have appeared, is of wider interest, however, for all who delight in reading of the habits of the wild folk of forest and field will find here fascinating descriptions

Courtesy of "La Nature"

A SUGGESTION FOR THE ZOÖLOGICAL PARKS OF AMERICA

The rejuvenating effect of open space, fresh air, and running water on a collection of caged monkeys has been demonstrated at the Zoölogical Garden, Regent's Park, London, where a new, huge monkey house was designed to reproduce a corner of the jungle with trees, grass, and a lake, fed by a small stream. The joyous surprise of the monkey-folk on experiencing this change from close confinement may well be imagined, but, what is equally important, their behavior under natural conditions may now be observed by the visitors to the Park. One monkey habit, at least of this London group, is illustrated in the above picture where the animals may be seen drinking from the bowled left hand. It is to be hoped that the practice of erecting outdoor habitats may be adopted by all other zoölogical gardens where the conditions will in any way allow from Mr. Fitzsimons' long personal experience with the animals of the Union. He devotes considerable space to the Primates, giving the concluding history of "Jack," the baboon who acted as signalman on the railway, whose feats Mr. Fitzsimons previously chronicled in his *Monkey Folk of South Africa*. The volumes are well illustrated with photographs of both the animals and their habitats.

Six scholarships for advanced study and research at American universities have been arranged for by the Imperial College of Science and Technology, London. Viscount Grey, lately British Ambassador to the United States, writes in this connection: "It is most desirable that young men of the rising generation, who will do much of the public work here and in America in the coming years, should get to know each other's universities. It will help both countries to realise how much the British and American peoples have in common, not merely in language, but in thought and in political views and aspirations."

The scientific work of the Smithsonian Institution for 1919 included many important explorations and field researches by members of the staff. Dr. Charles D. Walcott, secretary of the institution, continued his studies of the Upper Cambrian formations of the Canadian Rockies. An expedition was made to La Paz, Bolivia, in the interests of the astrophysical observatory, and successful photographs were taken of the total eclipse of the sun on May 29. Zoölogical collecting was pursued in Australia, French Congo, and Santo Domingo, and Dr. Paul Bartsch continued his experiments on marine invertebrates on the Florida Keys. A survey was undertaken of the vegetation of Glacier National Park, Montana, to serve as a basis for a popular account of the flora by the National Parks Association. In the fields of archæology and anthropology the institution continued the excavation and repair of the cliff dwellings in Mesa Verde National Park, Colorado, and made other excavations in Arizona and Utah. Extensive field work was also carried on among the living Indian tribes.

The director of the United States Bureau of Mines, Dr. Van H. Manning, resigned on June 1 to accept the directorship of research for the American Petroleum Institute. In his letter of resignation to the President Dr. Manning wrote as follows: "In leaving the government service there comes to me, as it has over and over again, the thought that although this government spends each year many millions of dollars in useful scientific work for the benefit of the whole people, the monetary recognition of its scientific and technical servants is not sufficient to enable them to continue in the service for the people. This has been especially true within the last few years when it has been impossible for many men to remain in the government service."

The salvaging of food fishes left stranded by the Mississippi River during its periodic floods, has proved one of the important functions of the United States Bureau of Fisheries.[1] When the river overflows, the adult fishes seek the quiet back waters to deposit their eggs. These are hatched in favorable places, but when the river again subsides, a large proportion of the young fishes are left land-locked in small lakes that will soon dry out by evaporation and seepage. These are rescued by the simple process of netting and depositing them in the open river. The work last year salvaged more than 150,000,000 food fishes. Assuming that 25 per cent of the rescued fishes survive and attain a marketable size, the bureau estimates their prospective value at about $6,500,000.

Dr. Augustus Trowbridge, professor of physics in Princeton University, has been granted a leave of absence in order that he may assume the chairmanship of the Division of Astronomy, Mathematics, and Physics, of the National Research Council, Washington.

The National Research Council has appointed a committee on eugenics under the chairmanship of Dr. C. B. Davenport, director of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences. This committee is arranging for the Second International Eugenics Congress which will be held in New York City on September

[1] "Fish Reclamation." *Bulletin of the American Game Protective Association*, Vol. IX, 1920, p. 11; Hugh M. Smith, "When the Father of Waters Goes on a Rampage." *National Geographic Magazine*, April, 1920, p. 369.

22–28, 1921. Officers of the congress were elected as follows: Dr. Alexander Graham Bell, honorary president; Professor Henry Fairfield Osborn, president; Mr. Madison Grant, treasurer; Mrs. Sybil Gotto, honorary secretary.

Dr. Ferdinand Broili has been appointed professor of geology and palæontology in the University of Munich to succeed Professor A. Rothpletz. Dr. Broili was a student of Professor Karl von Zittel and reviser of the latter's famous *Grundzüge der Paläontologie*.

For the purpose of investigating all proposed state memorials to Theodore Roosevelt, a bill was passed at the last session of the New York State Legislature and was signed by the Governor, creating a commission of six members, two to be appointed by the Senate, two by the Assembly, and two by the Governor. The commission is to act without compensation (other than its actual and necessary expenses, for which an appropriation of $1000 was made), and to report to the Legislature and Governor on or before January 1, 1921.

To carry out the provisions of the bill, the Speaker of the Assembly has appointed Messrs. Louis A. Cuvillier, of New York, and Raymond T. Kenyon, of Ausable Falls; Governor Smith has appointed Mr. Peter D. Kiernan, of Albany, and Professor Henry Fairfield Osborn, of New York.

Mr. James M. Macoun, systematic botanist and the chief of the biological division of the Geological Survey of Canada, also at one time attached to the fur-seal investigations of Bering Sea, died in May at the age of 58 years. Mr. Macoun's father was also a naturalist of the Survey and the two contributed more than 100,000 specimens to the National Herbarium.

The naturalist, Dr. F. E. Blaauw, of Holland, who has just returned from a study of the forests of *Araucaria*, a tree of ancient lineage still surviving in Chile, affirms that he has not seen in his extensive travels in South America or elsewhere forests comparable with the redwoods of northern California—especially the assemblage of giant trees in the Bull Creek forest. Through the work of the Save the Redwoods League in the period of delayed action by Congress the reservation of large tracts of redwoods is taking on international interest and importance.

Dr. John C. Merriam, the new president of the Carnegie Institute (see page 253), has been connected officially with the work of the Save the Redwoods League from its inception; he has been the executive head since June, 1920. The following paragraph quoted from Professor Henry Fairfield Osborn not only includes an encomium on the work of such public-spirited citizens and men of science as Dr. Merriam, but also sets forth the unanswerable argument for the reservation of the redwood forests, for leaving our national parks without industrial encroachment, and for devoting all governmental reservations in all parts of the country to recreational purposes:

> The leaders in great conservation movements in all parts of the United States and the men who are fighting hardest to protect and preserve what has already been won are those who have faith in the higher attributes of our human nature and believe that these attributes should be preserved at all costs and if necessary at any commercial or economic sacrifice. But so closely are the spiritual, the moral, and the physical interrelated in man that the conservation of the spirit and of the intellect is also guaranteed by the perpetuation of our physical wellbeing. Anyone who has observed the continuous stream of travel from the torrid cornfields of Nebraska and Kansas, or from the sweltering arid valleys of the California wheat belt, into the cool retreats of the great Yellowstone National Park or into the glories of the Yosemite and the Sierras, will not hesitate for long in the realization that in saving the wondrous redwood belt of northern California we are also saving the very best spiritual and moral forces of the people.

Dr. Carlos Ameghino has been appointed director of the National Museum of Natural History, Buenos Aires. Dr. Ameghino explored Patagonia many years ago, and made the collection of fossil vertebrates described by his brother, Dr. Florentino Ameghino, a distinguished palæontologist, who also was director of the National Museum from 1902 until his death in 1911. An official edition of the complete works and scientific correspondence of Dr. Florentino Ameghino is being published in La Plata by the minister of public works of the Province of Buenos

Aires. The editor, Sr. Alfredo J. Torcelli, requests everyone who has received scientific correspondence from Dr. Ameghino to send him copies of the letters in order that they may be included in the collection. Two of the volumes have already appeared.

The Ecological Society of America, a coöperative organization comprising zoölogists, botanists, foresters, agriculturists, climatologists, and geographers, has inaugurated a new journal to be known as *Ecology*. For this purpose the society took over the magazine *Plant World* which it will continue under the new name and policy. Mr. Barrington Moore, president of the society, will serve as editor-in-chief.

A memorial meeting in honor of the late Dr. Abraham Jacobi was held by the New York Academy of Medicine on May 6, his ninetieth birthday anniversary. Mr. George McAneny, executive manager of the *New York Times*, presented the academy with a bas-relief of Dr. Jacobi. The address of the occasion was delivered by Dr. George E. Vincent, president of the Rockefeller Foundation.

Dr. W. W. Keen has been elected an honorary fellow of the Royal Society of Medicine (London) and of the American Surgical Association.

The cost of publication of scientific periodicals and reports of learned societies is a serious problem in this country and bids fair to become disastrous in Europe. A leading editorial in the British weekly, *Nature*, appeals for government aid and endowment for the purely scientific papers. Increase of the circulation of such magazines is practically impossible and the incomes of scientific workers have already so decreased relatively that they cannot afford to pay an increased price. "Plutocrats will pay high prices for the pictures they want, and popular authors and musical composers may amass riches from royalties on their works; but the science worker is deprived of any such rewards for his discoveries, although all the world may benefit by them. Not only does he bring his rich argosies into port, but he also describes his cargoes fully, and *himself pays for the publication* of the catalogue of gifts which he is prepared to bestow freely upon all who care to receive them. . . . Altered circumstances, however, make it necessary to reconsider this position, and we urge that it is time the community, through its rich citizens or the Government, provide reasonable contributions toward the expenses of publications which bring honour to them as well as add to the sum of human knowledge."

Some months ago Mr. Walter R. Shaw, of the University of the Philippines, writing in *Science*, pointed out the danger attendant upon open-air swimming, because of the same optical illusion that causes us to experience a sensation of moving backward when a train we are in is passed by one of swifter motion going in the same direction. Mr. Shaw has observed that a person swimming with the wind, and consequently with the waves, which travel much faster than he possibly can swim, receives the impression of being carried backward in the water. This often leads an inexperienced swimmer to believe that he is caught in the "undertow." In his panic he overexerts himself, with the result that he may become exhausted before he can reach a footing. When our schools and colleges give publicity to this optical illusion in courses dealing with physics, physiology, and physical culture, and teach the wisdom of choosing some fixed object by which to gauge progress, the danger will be lessened.

Pending the publication of an extensive article in Natural History describing the work of the American Museum's Second Asiatic Expedition to North China and Mongolia, Mr. Roy Chapman Andrews gives the following notes regarding the material which was obtained and placed on exhibition in the Museum:

The work was in especial reference to the proposed hall of Asiatic life of the Museum and the installation of certain groups representing the fauna of Asia. Chief among these groups is a splendid series of bighorn sheep, the argali, of Mongolia. Seven specimens, which represent a world's record for this species, show the horn growth from its beginning in the year-old animal to its culmination in the magnificent ram. Only a few bighorn sheep remain in China, and these will undoubtedly soon be exterminated when the railroad is extended from Feng-chen to within six miles of their haunts and Peking and Tientsin sportsmen flock to these hunting grounds. The expedition collected also an interesting species of Asiatic wapiti or elk. It is estimated that probably not more than from fifty to sixty animals of this species remain.

In Mongolia splendid group material representing the antelope and marmot of the plains and the roebuck of the forests was obtained, also specimens of wapiti, musk deer, wild boar, and other animals from the Urga region. Urga is an especially advantageous base for collection work; it lies at the point of junction of the Central Asiatic life zone on the south and the Siberian zone on the north. Within a very few miles in either direction from Urga the collector can find two totally different faunas. The forests consist of large pine, spruce, birch, willow, and alder, and the birds as well as the mammals are typically Siberian. The ptarmigan, capercaillie, and hazel grouse are among the most distinctive birds, and the great variety of voles (*Microtus*), squirrels, chipmunks, weasels, wolverines, and martins indicates the northern character of the fauna. The plains fauna include such distinctive species as the antelope, marmot, pole cat, wolf, hamster, vole, and kangaroo rat.

After returning from Mongolia at the beginning of October, work was conducted in northern Shansi Province, twenty miles from the southern Mongolia frontier. Here sheep, wapiti, roebuck, and goral, besides a considerable series of small mammals, were obtained. In early December especially efforts were made to obtain a series of wild boar in the Shansi Province. Four fine animals were collected altogether, with other species new to the Museum's collections. During the seven months of actual field work about 1300 animals were obtained, most of them from localities which had hitherto not been visited by naturalists.

THE cat-tail (*Typha*) has been experimentally investigated as a possible source of food supply by Professor P. W. Claassen, of Cornell University.[1] The root stalks or underground stems (rhizomes) of this common swamp plant were known as a source of nutritious sweet flour to some of the eastern Indians, but although the white man quickly learned from them the value of maize and potatoes, they completely ignored the cat-tail. The rhizomes are perennial storage reservoirs of starch which can be ground into a very palatable flour. Examination by the Plant Chemical Laboratory at Washington showed 81.41 per cent carbohydrates and 7.75 per cent protein. This approximates the protein content of rice and corn flours. The laboratory reported that cat-tail flour can be used to the extent of from 10 to 20 per cent as part substitute for wheat flour. Professor Claassen calculated that an acre of cat-tails would yield considerably more than two tons of flour, and there are thousands of acres of cat-tail marshes in the country which annually could produce thousands of tons of this nutritious food.

[1] *Scientific Monthly*, Vol. IX, 1919, p. 179 ff.

THE transplantation of sea anemones by a hermit crab when the latter moved from

Courtesy of Susan B. Dinsmore, Mesa, Arizona

This photograph of "James, with Bobbie," a rescued young robin, appeared in *Bird-Lore* for May–June, 1919. It is a pleasure to present James to the readers of NATURAL HISTORY. His face assures us that the fact that "Grandpa's bean crop was saved while a neighbor's was eaten up by bugs" was not the young robin's greatest work—and that *economic* value is not our strongest plea for protection of our native birds one mollusk shell into another is recorded in a communication to the National Academy of Sciences. The observations were made by Dr. R. P. Cowles in the laboratory of Johns Hopkins University. The crab which inhabited a shell bearing three anemones was presented with a clean *Dolium* shell larger than the one in use. It moved into the new shell and then immediately proceeded to pull off the anemones from its old home with its pincers. After considerable rough handling these delicate animals were all three removed, without injury, to the new shell to which they attached themselves. One of the anemones, instead of contracting as it regularly does if disturbed, remained expanded throughout the mauling. It is supposed that the hermit crab derives some advantage from the presence of anemones in the probable protection afforded by their stinging cells against fishes that would prey upon it.

The Smith Yellowstone Park Bill failed of passage in the late session of Congress, but was not defeated and will come up again in the December session. It would permit the building of reservoirs in Yellowstone National Park to supply certain Idaho farms during occasional dry seasons. If the measure should ever pass, two enormous reservoirs would submerge the thicket and forest land of the southwest corner of the park where are situated the home and last stand of the Yellowstone moose. Further, the bill is an innocent-looking attempt to establish a precedent under cover of which attacks can be made on Yellowstone Lake, and probably other parks. The National Parks Association and other organizations and individuals rallied to the defense of the public property and succeeded in putting off the difficulty for a time, but in the next Congress Montana also will probably be prepared to support a similar attack. All friends of the national parks must undertake a regular task of educating both Congressmen and their constituents in the value and necessity of preserving our national parks from all commercial encroachments.

The New York Botanical Garden has acquired two collections of plants from the Big Cypress Swamp of Florida. One of these consists of the medicinal plants known to the Seminole Indians who lived in and about the swamp. It is the first collection of its kind ever brought together.

A permanent exhibition of sugar substitutes has been installed in the Philadelphia Commercial Museum. There are glucose, honey, maple sugar, milk sugar, and saccharine—the last the coal-tar derivative which is five hundred times as sweet as cane sugar. There is sorghum molasses from our southern states, and various foreign sugars are included, such as barley sugar from Japan, palm sugar from the East Indies, and palm sirup from Peru. Also there are special sirups for use in confectionery, soft drinks, medicines, bread and pastry (where sirup is substituted for yeast), and even for dissolving starch in the laundry.

Professor T. D. A. Cockerell, of the University of Colorado, has been elected an honorary fellow of the American Museum in recognition of his distinguished services to science.

The department of geology of the American Museum has in preparation a series of relief models representing topographic and geologic features of selected areas. The models now in progress are representations of the Mount Washington region of New Hampshire, the Mount Tom–Mount Holyoke range region in Massachusetts, the Watkins Glen region in central New York, the sink-hole region of the Standing Stone district in eastern Tennessee, and the Porto Rico and Virgin Islands region with their surrounding sea bottom.

The department of anthropology of the American Museum has received a collection of dancing costumes, everyday apparel, ornaments, and household utensils from western Tibet. The collection was presented by Mr. J. P. Morgan, trustee of the Museum, and was collected by Dr. H. B. Marx, of Nazareth, Pennsylvania, a medical missionary who has spent sixteen years in Tibet.

A collection of 3200 land birds collected in the West Indies and South America by Mr. Rollo H. Beck, has been presented to the American Museum by Mr. Frederick F. Brewster. The collection includes many birds from the high mountains of Santo Domingo, about five hundred from Bahia, Brazil, and a representative series from Tierra del Fuego and the Falkland Islands. The accession is unusually rich in species rare to museum collections and contains the type of a new genus of goatsuckers.

Dr. Henry E. Crampton, curator of invertebrate zoölogy in the American Museum and professor of zoölogy in Columbia University, left New York City in May on an expedition to southern Asia and Oceania. He will stop at Guam and several of the Ladrone Islands, the Philippines, and Hongkong. He will then proceed by way of southern China to Singapore, Bangkok, and the interior of Siam. Subsequently he will visit the Dutch East Indies and return to the United States by way of Australia and New Zealand. This is Dr. Crampton's eleventh tropical expedition. It is conducted with the coöperation of the Bishop Museum of Honolulu and the National Geographic Society of Washington and is financed in part through contributions from friends.

Dr. Frank E. Lutz, associate curator of invertebrate zoölogy in the American Museum, left New York the middle of June on the third of a series of expeditions for the study of insect distribution in the Rocky Mountain region. The first of these journeys was made to Arizona and the second through Colorado (described by Dr. Lutz in the present number of Natural History, on pages 312–325). This summer Dr. Lutz is collecting in southern and western Wyoming, southwestern Montana, the northern Salt Lake Valley, Utah, and at Tennessee Pass, Pueblo, and Lamar, Colorado.

The department of invertebrate zoölogy in the American Museum has installed in the Darwin Hall a group representing the sea animals and plants to be found within an area of two square inches of shallow sea bottom. The group represents the life in this area magnified twenty-five diameters (more than 15,000 times), and emphasizes particularly the incrustations composed of the minute Bryozoa or moss animals commonly found on shells, stones, and seaweed. Seven species of these are given. Other forms associated with these include microscopic hydroids in the act of budding off tiny medusæ or jellyfishes, certain Protozoa, a sea spider, and a colony of ascidians undergoing metamorphosis. The group occupies one of the window spaces, through which the light is infiltrated by means of a succession of transparent backgrounds painted on plate glass. On the front of the case is modeled a huge magnifying glass forty inches in diameter through which the visitor looks to view the group. Framing the magnifier is a transparency colored to represent in natural size the portion of the sea bottom from which the two-inch area was selected. The modeling in the group was done in glass, wax, celluloid, and plaster by Messrs. Herman Mueller, Chris E. Olsen, and Show Shimotori of the American Museum preparation staff. The group was designed by Mr. Roy W. Miner, associate curator of invertebrate zoölogy, and prepared under his direction.

Five thousand reprints of "Sequoia—the Auld Lang Syne of Trees," by Professor Henry Fairfield Osborn, the article on the California redwoods published in Natural History for December, 1919, have been presented to the Save the Redwoods League by the author. They will be used as campaign matter especially in the West to increase knowledge of the forests of giant redwoods along the Pacific slope of the Coast Range.

One of the activities of the American Museum during the World War was the preparation of plans of what is designed to be an ideal field hospital, portable, open on all sides in summer, embodying the latest experience from Great Britain and France. The work was done at the Museum under the direction of President Henry Fairfield Osborn, by Chief of Construction H. F. Beers. A large working model was exhibited in New York and San Francisco. The trustees of the Museum are now presenting all the working plans and models to the School of Hygiene and Public Health of Johns Hopkins University, Maryland, an institution of which the distinguished pathologist, Dr. William H. Welch, is director. On July 31, Dr. Welch acknowledged receipt of the plans as an interesting addition to the museum collection of the School of Hygiene.

Fifty posters designed by children of New York City grade schools to promote the teaching of kindness to animals were displayed in the American Museum in May and attracted unusual attention. They represented a competition carried out under the auspices of the New York Women's League for Animals.

Mr. Roy W. Miner and Dr. E. O. Hovey represented the American Museum of Natural History at the fifteenth annual meeting of the American Association of Museums, held in Washington May 17–18. Mr. Miner's term as councilor had expired and Dr. Hovey was elected councilor. Papers were read on "Microscopic Animals in Museum Groups" by Mr. Miner, on "Museum Coöperation" by Dr. Hovey, and on "Mounting Geological Specimens with Sulphur" by Dr. Hovey for Dr. Chester A. Reeds, associate curator of invertebrate palæontology in the American Museum.

Mr. Leslie Spier, assistant in anthropology in the American Museum, has been appointed associate curator for 1920–21 of the Museum of the Department of Anthropology in the University of California.

Mr. H. E. Anthony, associate curator of mammals in the American Museum, and Mr. George K. Cherrie, noted field naturalist, sailed on June 18 for southern Ecuador. The expedition is in continuation of the biological survey of South America inaugurated in 1911 by Dr. Frank M. Chapman.

Ensign William S. Flower, grandson of a great former director of the British Museum, Sir William Flower, visited the American Museum recently. His father, Capt. Stanley S. Flower, is director of the Giza Zoölogical Gardens near Cairo. Ensign Flower writes from Cairo a gratifying letter regarding preservation of birds:

> Lord Kitchener's bird protection laws of 1912 have resulted in an increase of cattle egrets from a few pairs to 25,000 birds bred in these gardens. They are almost entirely insectivorous and very useful to farmers. Some go as far as twenty to thirty miles every day, while the whole colony returns at night. The Egyptian hoopoo, which was once very rare, can be seen any time of the day in the gardens and I've counted as many as eight together, while several come within a few feet of us on the verandah.

The library of the American Museum has continual inquiry for back numbers of the American Museum Journal and Natural History, and urges that those subscribers who have copies which are not further needed will send them to the Librarian. They may be sent by express, collect.

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

Patron, August Heckscher.

Honorary Fellow, Professor T. D. A. Cockerell.

Life Members, Mrs. William Randolph Hearst, Miss Annie M. Alexander, Messrs. Joseph Ainslie Bear, Samuel Bird, and Arnold F. Riegger.

Sustaining Members, Mesdames Hazel Doris Cartier, Coleman du Pont, John T. Pratt, Messrs. Louis Pierre Cartier, and W. I. Walter.

Annual Members, Mesdames Addison Brown, M. Le Brun Cooper, W. H. Ebbitt, Carl Ferenbach, Wortham James, Barent Lefferts, A. Rogers-Jenkins, Miss A. Lagemann, Count Guillaume de Grunne, Doctors F. Elmer Johnson, Ellice McDonald, Messrs. Daniel D. Adee, Jerome C. Adler, John J. Amory, Kimball C. Atwood, William W. Bainbridge, Samuel H. Bijur, Martin Birnbaum, Arthur N. Cooley, John Gerow Dutcher, Marmont Edson, Geo. W. Freeman, Chas. A. Fulle, Aaron Garfunkel, G. H. Gossler, F. W. Humphreys, Gilbert H. Johnson, Otto Kafka, W. B. Kibbee, Geo. W. Knoblauch, J. M. R. Lyeth, Gilbert S. McClintock, Nathan J. Miller, William B. Nichols, Clarence M. Ryan, Daniel Smiley, Arthur S. Somers, Gerard Swope, Hugo Weigert, Richard Whitney, Master Agnew Allen Talcott, and The University Society.

Associate Members, Mrs. Laura G. Bartels, Miss Ruth W. Newcomb, Judge Frederick W. Henshaw, Doctors Winterton C. Curtis, William W. Graves, Messrs. Wm. L. Dobbin, Edmund B. Fladung, Ronald A. Foster, Edwin Fowler, N. B. Pendergast, Ralph M. Reahard, Clarence Snider, Harry S. Swarth, and Master William Appleton Aiken.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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

SEPTEMBER–OCTOBER, 1920

VOLUME XX, NUMBER 4

NATURAL HISTORY

VOLUME XX CONTENTS FOR SEPTEMBER–OCTOBER NUMBER 4

M. C. DICKERSON, *Editor*

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

Subscriptions should be addressed to the Secretary of the American Museum, 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.

THE AMERICAN MUSEUM OF NATURAL HISTORY

MEMBERSHIP

For the enrichment of its collections, for scientific research and exploration, and for publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 5300 friends are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Benefactor		$50,000
Associate Founder		25,000
Associate Benefactor		10,000
Patron		1,000
Fellow		500
Life Member		100
Sustaining Member	annually	25
Annual Member	annually	10
Associate Member (nonresident)	annually	3

Full information regarding membership may be obtained from the Secretary of the Museum, 77th Street and Central Park West.

WHERE THE MONGOLIAN BIGHORN SHEEP ARE FOUND

One of the expedition's hunters looking for sheep in the valleys and on the uplands of the rugged mountains of north Shansi Province, China. Here was collected the group of sheep for the hall of Asiatic life of the American Museum

NATURAL HISTORY

VOLUME XX SEPTEMBER-OCTOBER, 1920 NUMBER 4

New Expedition to Central Asia

TO THE EARTH'S MOST ANCIENT CENTER OF HUMAN DISPERSAL

By ROY CHAPMAN ANDREWS

Associate Curator of Mammals of the Eastern Hemisphere, American Museum of Natural History, and Leader of that institution's First and Second Asiatic Zoölogical expeditions

THE American Museum's Zoölogical Expedition to Mongolia described on pages 356 to 373 of this magazine, together with the First Asiatic Zoölogical Expedition to Yunnan in 1916–17, yielded such valuable scientific collections that it has been decided to conduct further work in Asia, along much broader lines. The Third Asiatic Expedition will extend its researches into the fields of palæontology, archæology, and anthropology, directing its attention mainly to the problem of the origin and development of primitive man.

"All authorities are today agreed in placing the center of dispersal of the human race in Asia," says Dr. W. D. Matthew in an important paper entitled "Climate and Evolution."[1] "Its more exact location may be differently interpreted, but the consensus of modern opinion would place it probably in or about the great plateau of central Asia. In this region, now barren and sparsely inhabited, are the remains of civilizations perhaps more ancient than any of which we have record. Immediately around its borders lie the regions of the earliest recorded civilizations,—of Chaldea, Asia Minor, and Egypt to the westward, of India to the south, of China to the east. From this region came the successive invasions which overflowed Europe in prehistoric, classical, and mediæval times, each tribe pressing on the borders of those beyond it and in its turn being pressed on from behind. The whole history of India is similar, —of successive invasions pouring down from the north. In the Chinese Empire, the invasions come from the west. In North America, the course of migration was from Alaska, spreading fan-wise to the south and southeast and continuing down along the flanks of the Cordilleras to the farthest extremity of South America. . . ."

Moreover, there is strong reason to believe that central Asia was the center of distribution for many of the mammals whose descendants are found living at present in other parts of the world. For instance, the moose, the wapiti or elk, the bighorn sheep, the so-called mountain goat, and the caribou which sportsmen are hunting in America today, are undoubtedly of Asiatic origin. I have shot species nearly related to every one of these animals in China, Mongolia, or on the borders of Tibet.

The wanderings of primitive tribes doubtless were influenced by many different causes, but, as these peoples were primarily hunters, one of the

[1] *Annals of the New York Academy of Sciences*, Vol. XXIV, pp. 209–10.

HEAD OF THE WORLD'S RECORD NORTH CHINA BIGHORN SHEEP

This species, *Ovis commosa*, is one of the group of Asiatic bighorn sheep which are known to the Mongols as "argali." This particular species, which will soon be extinct, is found in the northern mountains of north Shansi and along the southern Mongolian frontier. The great ram will form the central figure of the group which will be prepared for the new hall of Asiatic life in the American Museum

THE HOME OF THE BIGHORN SHEEP

The sheep feed in the valleys shown here and also on the uplands farther to the west. When disturbed, they cross into the rough peaks and are exceedingly difficult to find. The mountains at these places reach an altitude of 7000 feet. The record sheep was killed on one of the ridges shown in the left center of the photograph. This view will be used as part of the background for the Mongolian bighorn group in the American Museum

Roy Chapman Andrews, leader of the Second Asiatic Zoölogical Expedition which has recently returned, on his pony "Kublai Khan" with the fleet-footed antelope as trophy of the chase. Mongol ponies are about the size of our western bronchos and are extremely strong and hardy. They will travel from forty to sixty miles a day without undue fatigue; also, they are fed no grain either in winter or summer, and find their entire food upon the grass of the plains. During the winter they grow a coat of hair five or six inches in length and resemble grizzly bears almost more than ponies. "Kublai Khan" was a very remarkable animal. He learned in a short time exactly how to do his part in hunting antelope and he enjoyed the sport keenly. His intelligence and faithfulness made him one of the most important members of the Asiatic expedition

most important influences must have been the movements of the game upon which they depended for food and skins. Therefore, the study of the early human race is, necessarily, closely connected with and dependent upon a knowledge of the Asiatic mammalian life and its distribution.

Although the importance of this region long has been recognized, *no systematic correlated study on a large scale along various branches of science ever has been attempted, and there is no similar area of the inhabited surface of the earth about which so little is known.* Studies in the zoölogy, botany, and geology of Asia have been carried on from time to time by sporadic expeditions, but without exception these have been confined to special investigations of a given subject.

The fossil history of eastern and central Asia practically is unknown. In North and South America, Europe, and Africa, extensive palæontological work has been carried on for years. This has given to the world the magnificent collections in the great museums of America and Europe and has formed the basis for reconstruction of the earth's history and its inhabitants hundreds of thousands and even millions of years ago. *Knowledge of the fossils of eastern Asia rests almost entirely upon the report on a small collection of teeth and fragmentary bones purchased in the medicine shops of Tientsin and described by a German named Schlosser.*

Material of this sort is of considerable value to the Chinese because they believe the fossils have wonderful medicinal qualities. These fossils are known as "dragon's bones," and whenever a fossil-yielding locality has been found, it is carefully concealed. Nevertheless, during the last three years, Dr. J. G. Andersson, mining adviser to the Chinese Republic, has been carrying on investigations on behalf of Swedish institutions and has made some remarkable discoveries. Dr. Andersson is virtually the first scientist who has ever collected fossils, personally, in China.

In archæology and anthropology our knowledge is well-nigh as deficient as in palæontology. But very little work has been done upon the remains left by pre-Chinese tribes or upon the living aboriginal inhabitants of eastern and central Asia. Accurate conclusions as to the migrations of primitive peoples and the origin and relationships of the civilized nations of the world can never be reached until a careful study of the aboriginal tribes of Asia has been made. It is of course impossible to predict whether primitive human remains ever will be found, but in such an untouched area, results of great scientific importance and popular interest will certainly be achieved.

Although there are no vast unexplored areas of Asia existing today, many comparatively large isolated regions have never been visited by white men. It is safe to say that no countries of the earth have been so inadequately and incorrectly mapped as central Asia and even large parts of such relatively accessible countries as China.

There are many reasons why this region has remained scientifically unexplored for so long a time. It is remote and difficult of access, consequently the cost of conducting work on a large scale is enormous. Moreover, the country itself and its inhabitants present unusual obstacles to scientific research. Not only are there great intersecting mountain chains, waterless deserts, and treeless plains, but in many parts the climate is too cold for effective work in winter. In some places the natives are exceedingly suspicious of foreigners, and religious superstitions handicap research as well as make it decidedly dangerous.

It can readily be seen that operations on an extensive scale require not only considerable preliminary study of the unusual conditions existing, but also strong financial support if they are to be successful. During the last ten years the American Museum of Natural History has carried on work along zoölogical lines in various parts of the Orient with the purpose of ultimately conducting investigations on an extensive scale. Its first and second Asiatic expeditions served to familiarize us with the conditions to be met and to pave the way for future work—besides bringing to the American Museum of Natural History the important zoölogical collections which form a nucleus for study and exhibition in the proposed hall of Asiatic life.

Because of the position which Asia occupies as a center of mammalian dispersal the establishment of an Asiatic hall in any museum which aims to consider the development of natural history as a whole, is of the foremost importance. In its great plan for the future, the American Museum of Natural History has incorporated such a hall. This will have not only an exhibition of mammals, but will also take on a truly faunistic character. In other words, the exhibits in the hall will be a synopsis of the life of Asia, past and present. The basis will be an exhibition of groups with painted backgrounds which will be so selected as to have a definite geographical and botanical as well as a zoölogical value. The high steppes of the Tibetan Plateau, the sandy wastes of the Gobi Desert, the snow-covered peaks of the Himalaya Mountains, the dense forests of the Malayan Peninsula, and the semitropical jungles of southern China will be shown, each with its attendant natural history. Thus the great lesson of the geographical and climatic factors that have controlled the distribution and development of life can be taught in an objective way. In addition there will be systematic collections of the most characteristic birds, mammals, reptiles, and batrachians. In the same hall as much as possible of the palæontological history will be shown in order to make the story complete.

In the consideration of plans to provide material for the new hall and to carry on scientific work along broad lines, attention was immediately directed by President Henry Fairfield Osborn, of the American Museum, to the American Asiatic Association and to the magazine *Asia* as being the most representative and effective organs in America for the diffusion of knowledge concerning the Orient and the promotion of cordial relations and of mutual understanding between the countries of the Far East and the United States. Accordingly the American Asiatic Association and *Asia* were invited to coöperate with the American Museum in financing the new expedition. At a meeting of the Executive Committee of the American Asiatic Association on June 14, a resolution was adopted unanimously endorsing the plan and pledging its support.

The work will be carried on under the name of "The Third Asiatic Expedition of the American Museum of Natural History, in Coöperation with the American Asiatic Association and *Asia* Magazine."

There is a very real desire on the part of the sponsors for the expedition to make it a factor in the development of the educational life of the Chinese Republic. China has no national institution wherein natural history objects can be studied and exhibited by modern methods and where the scientific work of her own people can be encouraged and directed.

The Western world has come to regard China as negligible from the standpoint of general scientific research. This condition has developed principally because there is no central institution in China which can become a focus for the efforts of her trained men. The gratifying results which already have been attendant upon the efforts of the Rockefeller Foundation in the teaching of medical science to the Chinese show what progress can be expected when similar aid is given along other branches of science.

The sponsors of the expedition, therefore, have decided to invite the Chinese government to coöperate with it in carrying on its work in the Orient. They will be invited to delegate to the expedition certain men who have already had preliminary instruction in various branches of science; these men while in the field will receive training in the modern methods of scientific exploration and study under the best specialists of the world.

When the expedition has been completed, its sponsors will agree to deposit in Peking a duplicate set, in so far as it is possible, of the collections obtained, which will form the basis of a "Chinese Museum of Natural History."

The proposed institution will then have a splendid nucleus of specimens for exhibition and study and the work will be carried on by a staff of Chinese who have received the best training possible. It will remain for the Chinese government to set aside a suitable building where the collections can be arranged for exhibition and study.

Moreover, if in the future the Chinese government wishes to send selected men to New York, the American Museum will undertake to furnish them opportunities for a thorough training in the various branches of museum work and modern methods of exhibition. In short, the American Museum will act as sponsor for the Chinese institution and endeavor to foster its growth and development in any way within its power.

If the Chinese government accepts our assistance in establishing such an institution, it will certainly become more than a "museum of natural history" in the strict sense. There are in China splendid remains of great archæological and historical value, not only to China but also to the entire world, which are being ruined irreparably by neglect and vandalism. Sporadic attempts have been made by various foreigners to arouse interest in the protection of these splendid monuments, which are among the most glorious relics of China's history, but they all have died a natural death through lack of a practical working basis. If the proposed museum is established under governmental auspices, a natural result will be the inauguration of an archæological survey having for its especial object the care and protection of these antiquities.

It is proposed to carry on the field work of the Third Asiatic Expedition for a period of five years. Headquarters will be established in Peking, from which the various parties will work in the interior of China, central Asia, Manchuria, and Kamchatka. The estimated cost of the expedition will be $250,000, or $50,000 annually for a period of five years. Up to the present time one half of this amount has been guaranteed. Besides the contributions of its sponsors, its inauguration has been made possible by the generous subscriptions of Mrs. Willard Straight, Messrs. J. P. Morgan, W. Averill Harriman, Childs Frick, George F. Baker, and Mr. and Mrs. Charles L. Bernheimer.

It is hoped that the remaining funds which are necessary if the work is to be carried on in the broad way which will make it most effective, will be subscribed before the expedition is ready to leave for the field.

The results of the Third Asiatic Expedition will be published in a series of scientific volumes which it is hoped will become the standard works on the natural history of central and eastern Asia for many years to come. Popular books, telling of the work and discoveries in nontechnical language and in a readable way, also will be prepared, and the progress and travels of the expedition will be presented in the pages of *Asia*, and in the official organ of the American Museum, NATURAL HISTORY.

Pictorially, there is an opportunity for splendid educational work of a highly interesting and important character. The plan is to show in motion pictures the entire history of the expedition. Not only will these films be exhibited in weekly serials throughout the United States, but complete stories of the life of remote tribes will also be prepared to show to the people of America the strange natives in these little-known corners of the world.

Assistants on the Second Asiatic Zoölogical Expedition bringing in roebuck killed in north Shansi Province, China, where the wapiti were collected

In Mongolia and North China[1]

By ROY CHAPMAN ANDREWS

WHEN I left Peking in late August of 1918 to cross Mongolia, I knew that I was to go by motor car. But somehow the very names "Mongolia" and "Gobi Desert" brought such a vivid picture of the days of Kublai Khan and ancient Cathay that my mind refused to admit the thought of automobiles. Not even on the railway when I was being borne swiftly toward Kalgan and saw the lines of laden camels plodding along the paved road beside the train, or when we puffed slowly through the famous Nankou Pass beside that wonder of all the world, the Great Wall, that winds like an enormous serpent over ridge after ridge of mountains, was my dream picture of mysterious Mongolia dispelled. I had seen all of this before and had accepted it as one accepts the motor cars beside the splendid walls of old Peking. It was all too near and the railroad had made it commonplace. But Mongolia! That was different. One could not go there in a roaring train. I had beside me the same old rifle and sleeping bag that had been carried across the mountains of far Yunnan, along the Tibetan frontier and through the fever-stricken jungles of the Burma frontier. Somehow these companions of forest and mountain trails did much to keep me in a blissful state of unpreparedness for the destruction of all my dream castles.

My first trip was with Mr. Charles L. Coltman, who was accompanied by his wife. His object was to visit his trading station at Urga, the capital of Mongolia, which was our destination; mine was to make a reconnaissance for zoölogical work the following summer. We left Kalgan early in the morning on horseback, for the cars were at a mission station forty miles away. About ten miles from Kalgan we began on foot the long climb up the pass which gives entrance to the great plateau. I kept my eyes steadily on the pony's heels until we reached a broad flat terrace halfway up the pass. Then I swung about that I might have, all at once, the view which lay below us. It justified my highest hopes. Miles and miles of rolling hills stretched away to where the far horizon met the Shansi Mountains. It was a desolate country which I saw, for every wave in this vast land sea was cut and slashed by the knives of wind and frost and rain and lay in a chaotic mass of gaping wounds,—cañons, ravines, and gullies painted in rainbow colors, crossing and cutting one another at fantastic angles as far as the eye could reach. When a few moments later we reached the summit of the pass I felt that no spot I had ever visited satisfied my preconception quite so thoroughly. Behind and below us lay that stupendous relief map of ravines and cañons. In front was a limitless stretch of undulating plain. I knew then that I really stood upon the edge of the greatest plateau in all the world and that it could be only Mongolia.

We spent the night at the mission station and at daylight packed the cars. Bed rolls and cans of gasoline were tied on the running boards and every corner was filled with food. For thirty miles we drove over a fair road bordered by fields of yellowing grain.

[1] Illustrations for this and the preceding article from photographs by Yvette Borup Andrews.

THE AUTHOR IN THE MONGOLIAN FOREST

The Mongolian roebuck is a species larger than any of the roe deer found in Europe or Asia. It has habits almost identical with those of our Virginia deer in America

A caravan of camels watering at a well in the desert of Gobi. The presence of the expedition's automobile, also at the well for water, afforded a striking contrast in methods of transportation

This species of wapiti or elk of northern China will soon be extinct. It is closely related to the wapiti of America. For many years the belief was entertained that wapiti were peculiar to the forests of North America, but in recent times they have been discovered in various parts of north and central Asia

We were seldom out of sight of mud-walled huts and tiny Chinese villages. Chinese peddlers passed our cars carrying baskets of fruit or of trinkets for the women. Chinese farmers stopped to gaze at us as we bounded over the ruts; in fact, it was all Chinese, although we were really in Mongolia. I was eager to see Mongols, to register the first impressions of a people of whom I had thought so much—but the blue-coated Chinaman was ubiquitous.

For seventy miles from Kalgan it is all the same—Chinese everywhere. The Great Wall was built to keep the Mongols out. By the same token it should have kept the Chinese in, but the rolling grassy sea of the vast plateau was too strong a temptation for the Chinese farmer. Encouraged by his own government, which knows the value of just such peaceful penetration, he pushes forward the lines of cultivation a dozen miles or so for every year. As a result, the grassy hills have given place to fields of wheat, oats, millet, buckwheat, and potatoes.

Beyond the area of agriculture we came to a region of long rich grass where water is by no means scarce. Flocks of goats and fat-tailed sheep drifted up the valleys, and now and then a herd of cattle massed themselves in moving patches on the hillsides; but they are only a fraction of the numbers which this land could easily support.

When we came to our first Mongol village, I jumped out of the car to take a photograph but scrambled in again almost as quickly, for as soon as the motor had stopped, a dozen dogs dashed from the houses snarling and barking like a pack of wolves. They are huge brutes, these Mongol dogs, and as fierce as they are big. Every family and every caravan owns one or more. We learned very soon never to approach a Mongol encampment on foot. The natural ferocity of the dogs is probably accentuated by the Mongol custom of throwing out their dead to be devoured by them, as well as by wolves and birds. This diet of human flesh must have a marked effect upon the animals which are naturally savage, and they are a very real danger to life. My wife and I had the narrowest escape from death which we have ever had in all our travels from these same dogs, and more than once when we were on horseback we were attacked by the snarling brutes.

A Mongol village is as unlike a Chinese settlement as it well can be. Instead of closely packed mud houses we found the Mongol habitation to be a circular latticed framework covered with felt, and with a cone-shaped roof. The yurt, as it is called, is perfectly adapted to the Mongolians and their life. In the winter a stove is placed in the center and the house is dry and warm. In the summer the felt covering is sometimes replaced by canvas which can be lifted on any side to allow free passage of the air. When it is time for the semiannual migration to new grazing grounds, the yurt is quickly dismantled, the framework collapsed, and the house packed on camels or carts.

At Panj-Kiang, the first telegraph station, we came to the "edge" of the desert. In reality, however, there is no edge to this part of the Gobi, for the grasslands, both on the south and the north, merge so imperceptibly into the more arid central region, that it is difficult to see where the Gobi really begins or ends. As a matter of fact there is no desert at all, in the popular sense of the word, between Kalgan and Urga. I was always looking for it, but never found it. Even in the most arid part in summer it resembles a rolling meadowland. When one looks more closely, one sees that the vegetation is mostly "Gobi sagebrush" and short bunch grass growing from a soil of fine gravel. Farther to the west the Gobi becomes a real desert, which Sir Francis Younghusband says is the most desolate waste of sand and gravel that he has ever seen.

There was no lack of bird life along the way. Thousands of mallard ducks and teal were in the ponds which we passed before we reached Panj-Kiang. Golden plover were often frightened by the car from their dust baths in the road, and crested lapwings flashed across the prairie like sudden storms of autumn leaves. Huge golden eagles and enormous ravens made tempting targets on the telegraph poles, and there were cranes in thousands.

The demoiselle crane, one of the most beautiful species of this splendid family, we found all the way across the Gobi; it comes to Mongolia to raise its young. Twice in the summer we found its nest—or rather eggs, for it makes no nest at all. The spotted brown eggs are laid quite openly on the ground and their coloration is their best concealment. In late June we caught two of the young just hatched. They were ridiculous little things, all legs and neck, with yellow crowns which made them appear entirely bald. It seemed hardly possible that they could grow into the graceful birds which wheeled in ever widening circles above our heads, their notes coming down to us faintly like the voices of happy children.

Now and then we left the road to shoot a bustard. These strange birds, relatives of the cranes and as large as turkeys, are always shy. Their enormous size makes them conspicuous on the plains, but they do not attempt concealment, depending upon their marvelous sight to protect them from enemies. We could seldom approach nearer than within two hundred yards and even at that distance they are not easy targets. Coltman shot one that weighed thirty-five pounds on the scales in Urga. It was the largest male bustard I have ever seen and had the bare throat patches of brilliant blue and the long side whiskers splendidly developed. Later I killed another, almost as large, which I had watched for half an hour through my field glasses. The female had flown away but the male strutted about with drooping wings and spread tail exactly like a turkey cock.

Just beyond Panj-Kiang we saw the first antelope. There always seemed to be antelope on the Panj-Kiang plain and many of them. We were comfortably rolling along on a stretch of good road when Mrs. Coltman, whose eyes are especially keen, excitedly pointed to a hillside on the right not a hundred yards from the trail. At first we saw nothing but the yellow grass. Then the whole hill seemed to be in motion. A moment later I began to distinguish heads and legs and to realize that it was an enormous herd of antelope closely packed together, restlessly watching us. Our rifles were out in an instant, and Coltman opened the throttle. The antelope were five or six hundred yards away and as the car leaped forward they strung out in single file across the plain. We left the road at once and headed diagonally toward them. For some strange reason when a horse or a car runs parallel with a herd of antelope, the animals swing in a complete semicircle and cross in front of the pursuers. Whether they think they are being cut off from some more desirable means of escape, I cannot say, but the fact remains that with the open plain on every side, they always try to "cross your bows."

I shall never forget the sight of those magnificent animals streaming over the desert. There were at least a thousand of them and their yellow bodies seemed fairly to skim the earth. I was shouting in excitement but Coltman said, "They are not running yet. Wait until we begin to shoot." I could

Mongol herdsmen carrying the lasso which consists of a twenty-foot pole with a sliding noose at the end. The natives handle such a lasso very expertly

A Mongolian water carrier with his camel in the Gobi Desert.—The wells are sometimes fifty or sixty miles apart and caravans carry water for their personal need in casks (such as are shown supported on the animal). The camels, when on the trail, travel four or five days, if necessary, without drinking

A Mongol woman looking at her portrait in a copy of an American magazine. This picture and the one opposite present two complicated methods of dressing the hair in Mongolia

scarcely believe my eyes when I saw the speedometer trembling at thirty-five miles an hour, for the animals were leaving us almost as though we were standing still. But then their fatal habit began to assert itself and the long column bent gradually in our direction. Coltman widened the arc of the circle and held the throttle open as far as it would go. Our speed increased to forty miles and the car began to gain because the antelope were running almost across our course. They were about two hundred yards away when Coltman shut off the gas and jammed both brakes, but before the car stopped they had gained another hundred yards. I leaped over a pile of bedding and as soon as my feet were on the ground came into action with the .250 Savage high power. Coltman's .30 Mauser was already spitting fire across the wind shield from the front seat, and at his second shot an antelope dropped like lead. My first two bullets struck the dirt far behind the rearmost animal, but the third caught a full-grown female in the side and it plunged forward into the grass.

I realized then what Coltman meant when he said that the antelope had not begun to run. At the first shot every animal in the herd seemed to flatten itself and settle to its work. Their legs became merely a blur like the wings of an electric fan and I wondered if even a bullet could catch them.

When the excitement was over, I began to understand the significance of what we had seen. It was slowly borne in upon me that our car had been going, by the speedometer, at forty miles an hour and that *the antelope were actually beating us.* I knew that they must have been traveling much faster than forty miles, for they were running in a half circle while we were going straight ahead. It was an amazing discovery; I had never dreamed that any living animal could run so fast.

It was a discovery which would be of considerable importance, too, in the investigations which Professor Henry Fairfield Osborn, of the American Museum, has been carrying on as to the relation of speed to limb structure in various groups of animals. I determined with Mr. Coltman's help to get some real facts in the case—data upon which we could rely. There was an opportunity only to begin this study on the first trip but we carried it further the following year. Time after time, as we tore madly after the antelope which were proceeding singly or in herds, I kept my eyes upon the speedometer, and I feel confident that our observations can be relied upon. We demonstrated beyond a doubt that the Mongolian antelope (*Gazella gutturosa*) can reach a speed of sixty miles an hour. This is probably the maximum, and after a short dash the animals must slow down to about fifty miles; a short distance more and they drop to forty or thirty-five miles, which they seem able to continue almost indefinitely.

The antelope never ran faster than

Wife of one of the expedition's hunters looking at pictures of Urga in a copy of an American magazine. It was the first time she had ever seen a photograph or its half-tone reproduction

was necessary to keep well away from us. As we opened the throttle of the car they too increased their speed. It was only when we began to shoot and they became thoroughly frightened that they showed what they could do. I remember especially one fine buck which gave us an exhibition of really high class running. It started almost opposite to us, when we were on a stretch of splendid road, and it jogged comfortably along at thirty-five miles an hour. Our car was running at the same speed, but the antelope decided to cross in front of us and pressed its "accelerator" a little. Coltman also touched ours and the car jumped to forty miles. The antelope seemed very much surprised and gave its accelerator another push. Coltman did likewise and the speedometer reached forty-five miles. That was about enough for us and we held our speed. The antelope drew ahead on a long curve and swung across in front of the car. It had beaten us by one hundred yards.

The antelope have developed this great speed, of course, to protect them from the wolves which range the plains. We determined definitely that a wolf when running for its life cannot do better than thirty-five miles an hour. With antelope that can run sixty miles an hour a wolf has little chance, unless he catches them unawares or finds the newly born young. To avoid just this the antelope are careful to stay well out on the plains where there are no rocks or hills which could conceal a skulking wolf.

Of course our work upon the plains was not conducted from a motor car. In the future we hope to use automobiles, for there are few places in Mongolia where they cannot go, but on this trip we abandoned the cars at Urga and did all our work from horseback with our camp equipment transported in carts. For two and one half months we worked on the plains within a few hundred miles of Urga. Although studying the life history of the antelope and obtaining specimens of them for a group in the new hall of Asiatic life at the American Museum was the most interesting part of the work, nevertheless the plains afforded a productive field for small mammal collecting.

After these delightful months we regretfully turned back toward Urga. Our summer was to be divided between the plains on the south and the forests to the north of the sacred city, and the first half of the work had been completed. Urga is an ideal place for a base camp, because it is at the junction of the Siberian and central Asian life zones. The former is sharply delineated by the limit of the trees, and on the south the central Asian zone has a plains fauna totally unlike the animals of the forests.

We remained only three days in the capital. Until then Mongolia, to us, had meant only the Gobi Desert and the boundless rolling plains. When we set our faces northward we found it was also a land of mountains and rivers, of somber forests and gorgeous flowers. We had learned that the Terelche

THROUGH MONGOLIA'S FLOWER-GROWN VALLEYS

The Second Asiatic Expedition on the way into the woods north of Urga. For the first half of the summer the expedition worked on the plains, and from the first of August until October it carried on collecting in the forests which stretch away in an unbroken line far beyond the Siberian frontier. The first three carts are drawn by Tibetan yaks, which are used as draft animals in Mongolia. In the foreground may be seen a few of the many flowers forming a brilliant carpet on the hills and valleys of northern Mongolia during the summer. There are acres upon acres of daisies, poppies, roses, and many other species

THE CARAVAN

The expedition crossing the Terelche River. — The carts are drawn by Tibetan yaks and ponies. The yaks, although very slow, can pull enormous loads. The rivers of northern Mongolia are sometimes very difficult to cross, for a few hours' downpour turns them into raging torrents

AT THE END OF THE LONG TRAIL ACROSS MONGOLIA

Camels arriving in the cultivated areas of China about sixty miles from Kalgan.—Practically all goods during the winter are transported across the desert by camels. In the summer ox- and pony-carts assume the transportation while the camels are resting and accumulating strength for the winter's work. Ox-carts take ninety days to cross Mongolia between Kalgan and Urga, camels require forty days, automobiles go in three and one half days, and aëroplanes will make the journey in six hours

A SOLITARY CAMP ON THE GOBI DESERT

A Mongol and his wife with a single camel are making their way across the plains and desert from Kalgan to Urga. They have stopped here to cook their dinner, and later will roll up in their fur coats and go to sleep under the stars. It rains but seldom in the desert and a tent is by no means necessary for comfort

River would offer a fruitful collecting ground. It was only forty miles from Urga, and the first day's trip was a delight. We traveled northward up a branch valley enclosed by forested hills and carpeted with flowers. Never had we seen such flowers! Acre after acre of bluebells, forget-me-nots, daisies, buttercups, and cowslips, converted the entire valley into a vast "old-fashioned garden," radiantly beautiful.

On the second morning, however, we awoke to a cloud-hung sky and floods of rain, instead of to golden sunshine. No one wished to break camp in the icy deluge, but between us and the Terelche River were three marshes which were bad enough in dry weather; a few hours of rain would make them impassable, perhaps for weeks. My wife and I look back upon that day and the next as among our few real hardships. After eight hours of killing work, wet to the skin and almost frozen, we crossed the first dangerous swamp and reached the summit of the mountain. Then the cart with our most valuable possessions plunged off the road on a sharp descent and crashed into the forest below. Chen, one of the Chinese taxidermists, and I escaped death by a miracle, and the other taxidermist, who was safe and sound, promptly had hysterics. It was discouraging, to say the least. We camped in the gathering darkness on a forty-five degree slope in mud twelve inches deep. Next day we gathered up our scattered belongings, repaired the cart, and reached the river.

We had a letter from a Mongol duke to a famous old hunter named Tserin Dorchy. All Mongols are independent, but Tserin Dorchy is an extreme in every way. He rules like an autocrat the half dozen families in the valley. What he commands is executed without a question. I was anxious that the expedition should move promptly and announced that we would start the day after our arrival. "No," said he, "we will go two days from now." Argument was of no avail. So far as he was concerned the matter was closed. When it came to arranging wages he stated his terms, which were exorbitant. I could accept them or not as I pleased. He would not reduce his demands by a single copper. Nevertheless, he was an excellent hunter, and we came to be good friends.

I made a base camp in the valley not far from his yurt and while the work on small mammals was carried on by the Chinese taxidermists, my wife and I hunted with the Mongols for larger game. On these trips our equipment consisted only of sleeping bags and such food as could be carried on our horses. It was a time when living close to nature was really necessary. By arranging a bit of canvas over the low branches of a tree we prepared a shelter for ourselves, and then made a second for the hunters. We became typical nomads, spending a day or two in some secluded valley only to move again to other hunting grounds. For the time, we were Mongols in all essentials. The primitive instincts, which lie just below the surface in us all, responded to the subtle lure of nature, and without an effort we slipped into the care-free life of these children of the woods and plains. We slept at night under starlit skies; the first gray light of dawn found us stealing through the dew-soaked grass on the trail of elk, moose, or bear; and when the sun was high, like animals we spent the hours in sleep, until the lengthening shadows sent us out again on the evening hunt.

For three months we worked near the Terelche River, and came to know every mountain and valley, every stream and marsh, as New Yorkers know their city. Our boxes held nearly one thousand specimens when we left the forest, all of which were unlike those we had obtained upon the plains. Wood pikas, voles, shrews, mice, and

ON THE GRASSLANDS OF MONGOLIA

A flock of fat-tailed sheep in the valley of the Tola River, one hundred miles west of Urga. This valley furnishes wonderful grazing and is a favorite resort in winter for Mongols. They raise thousands of sheep for the mutton which forms 75 per cent of their food, and the skins which they use for clothing. The possibilities for the production of mutton, beef, wool, and hides seem limitless on the northern and southern grasslands of Mongolia

A wrestling contest in the field meet of the Terelche Valley.—The Mongolian wrestler usually takes hold of his opponent's waistband and endeavors to obtain a fall by sudden heaving

Women of southern Mongolia in front of their yurt—the portable felt-covered tent which is the Mongol's home in all parts of the country. Compare the hairdress of red coral and beads which these women of southern Mongolia are wearing, with the remarkable hornlike projections over which the hair is dressed by the women of the north (see pp. 362 and 363)

squirrels had been caught in traps. To my rifle had fallen bear, roebuck, wild boar, musk deer, moose, and elk. The forests yielded up their treasures as we had dared not hope they would, and we left them with almost as much regret as we had left the plains.

It was late September when we returned to Urga. For a month there had been heavy frosts at night and several storms of snow and hail. We knew that any day might plunge us into winter, and although Mongolia is a paradise in summer, its winters are to be avoided. The temperature sometimes drops to seventy degrees below zero and the bitter winds which sweep across the plains make it one of the coldest spots on earth.

On October first the specimens were started southward on camel back, while we left by motor car. Five days later we were in Peking, and I was greeting the Reverend Harry R. Caldwell, who was to join me for a trip to the northern edge of Shansi Province after the Mongolian bighorn sheep.

Mrs. Andrews feeding a white-maned serow.—This animal was captured when only a few weeks old and became as tame as a domestic goat. Serows are exceptionally rare in zoölogical gardens and there is none on exhibition in America. The expedition desired to bring this specimen to the New York Zoölogical Society, but the Department of Agriculture at Washington could not permit the animal to be landed because of restrictions regarding Asiatic cattle diseases. The serow is an intermediate stage between the true goats and the antelopes and is closely related to the so-called Rocky Mountain goat of America

The hunting grounds are only five days' travel from Peking and many foreigners have turned longing eyes toward the mountains which hold the sheep; but the region is infested with brigands, and since Sir Richard Dane, formerly foreign chief inspector of the Salt Revenue, and Mr. Charles Coltman had been driven out by the bandits in 1915, the Chinese government had refused to grant passports to foreigners who wished to shoot in that region. The brigands cannot waste cartridges at one dollar each so the animals had been allowed to breed unmolested. Nevertheless, not many sheep are there. They are the last survivors of the great herds which once roamed the mountains of all north China. The technical name of the species is *Ovis commosa,* and it is one of the group of bighorns known to sportsmen by the Mongolian name "argali." In size as well as ancestry these are the grandfathers of all the sheep. The largest ram of our Rocky Mountains is a pygmy compared with a full-grown argali.

The supreme trophy of a sportsman's life is the head of a Mongolian ram, for it can be obtained only by the hardest work. I think it was Rex Beach who said, "Some men can shoot but not climb. Some can climb but not shoot. To get a sheep you must be able to climb and shoot too." For its proposed hall of Asiatic life, the Museum badly needed a group of argali. Moreover, we wanted a ram which would fairly represent the species, and we wanted a very big one.

The brigands did not worry us unduly. Both Mr. Caldwell and I have had considerable experience with Chinese bandits and we feel that they are like animals in that if you do not tease them they will not bite. In their case the "not teasing" implies carrying nothing that they could readily dispose of, especially money. The Chinese Foreign Office did not know, of course, where we were going. Our passports were viséed for Shansi, but had the officials suspected our destination orders would have been issued to prevent us from going into the mountains.

Our plan was to avoid the main roads, and strike off into the hills before the authorities knew where we had gone. The plan was successful and we made our camp at the little village of Wu Shi-tu, where we obtained two Mongolian hunters. I cannot tell in detail of those glorious days in the mountains. The hunt there is a story in itself. Suffice it to say that we were more successful than we had dared to hope. When we returned to Peking, our carts contained a magnificent ram with the world's record head, and six other sheep illustrating the stages of horn growth in a splendid way. Moreover, we had obtained three fine wapiti, representing a species which will soon be extinct in north China. Besides these, we had seventeen roebuck, two gorals, and a large series of hares and smaller mammals.

One other successful trip to the mountains of central Shansi, this time for wild boar, completed the field work of the Second Asiatic Expedition. It only remained to pack the specimens and to transport them to New York. They safely reached the American Museum, not long after we ourselves arrived there, through the assistance of Mr. A. S. Jackson, of Shanghai, passenger agent of the Canadian Pacific Ocean Service. It is useless to gather specimens in the field unless they can be brought to the museum *in perfect condition,* and it was an especial pleasure to find, when the cases were opened, that not a single skin had suffered from the long journey.

Mr. Jackson's aid is only one instance of the cordial coöperation which we received throughout our work in the Orient. The universal courtesy of the Chinese officials and the resident foreigners was delightful, and on the other hand, it was a source of pride to us that we were representatives of the American Museum of Natural History, whose educational work has won recognition throughout the world.

TIBETAN YAKS DOMESTICATED IN NORTHERN MONGOLIA

This great oxlike animal does not occur wild in Mongolia, but numbers have been domesticated and brought to the vicinity of Urga for use in drawing heavy loads. The yak is often interbred with the domestic cattle. These crossbreeds can always be distinguished, however, by the fact that they do not have an extremely bushy tail which is characteristic of the pure-blooded yak and which is well shown in the photograph. The animals make a loud grunting noise, comparable with that of the pig

Social Evolution: A Palæontologist's Viewpoint

By W. D. MATTHEW

Curator of Vertebrate Palæontology, American Museum

IN a recent address a well-known newspaper editor is quoted as saying: "To me the lack of proof of any improvement of the human mind as far back as history goes is the most impressive proof of the creation of the human mind, against the theory of evolution."

This is a brief reference to what may appear to well-informed and fair-minded people a very weighty argument. Especially it might appeal to anyone well versed in history and in classic literature but more superficially acquainted with modern geology and modern evolutionary doctrines. To the palæontologist, on the other hand, evolution appears not as a theory at all but as a general law, a matter of fact and record so far as he deals with it. He is so far saturated with evidence of it, so accustomed to seeing its application to all aspects of life that come under his view, that it seems impossible to believe that a reasonable man could question it any more than the laws of physics and chemistry.

Yet I think that the statement quoted above, in the sense that its author doubtless meant it, is at all events approximately true, however unacceptable the inference he draws from it. So far as my own reading would lead me, it is accurately true. I cannot see that there is any evidence of the improvement of the human intellect in historic time. The Dialogues of Plato appear to be written for minds fully as acute as those of modern students of philosophy. The perceptive and reasoning powers of the writers of the Bible seem to be on a par with those of modern writers. The accumulation of knowledge has of course led to great progress in our acquaintance with facts and the generalizations based on facts. It has involved a still greater progress in material civilization; and these features of progress have been tremendously accelerated by the invention of printing and improvement of means of intercommunication. But in intellectual ability *per se* I cannot see that there is any conclusive evidence of advancement; and certainly, if there is any, it is not great.

There is, however, another aspect of the human mind in which I think there is very clear evidence of progress. This is the moral or ethical as contrasted with the intellectual side. Here, I think, one may see both in precept and in practice, a marked advance, a steady improvement, fairly continuous upon the whole, and resulting in a notable contrast between the standards that we see represented in the writings and actions of early peoples, and those which prevail today. I use the term "moral qualities" in its broadest sense to include all those inhibitions and restraints, those actions and thoughts which prefer the ultimate advantage of the individual to his present advantage, which sacrifice a lesser individual benefit for a greater race benefit, which tend to the development of social life and more elaborate social organization.

Consider the moral standards of the Old Testament as compared with those of today. How would we regard David, "the man after God's own heart"? An able warrior, no doubt, clever, active, well-meaning, magnetic, a good fellow on the whole, but surely something of a weak brother. How would he measure up with Washington, with Lincoln, with William Pitt? "The righteous man sweareth an oath and keepeth it *even* though it be to his own hindrance." Surely that is not so remarkable in the modern righteous man as to call for special and rather surprised commendation. "An eye for an eye and a tooth for a tooth." Are these the ideals of our modern treatment of criminals? Rather, one would say they are the standards that prevail among the criminal classes themselves.

Or, take the matter of self-control, of the regulation and management of one's daily life and habits. How many of the kings and leaders of olden time were able to withstand prosperity, to refrain from indulgences that shortened their own lives and ruined the prestige of their dynasties in one or two generations? Does not the whole of ancient history leave one with an impression of gorging and feasting without regard for the morrow, of snatching at the pleasures of the moment often at a terrible future cost? Contrast with this the sober regularity of the average civilized man of today, the diligence and abstemiousness of most modern leaders, political or financial. It is useless here to cite examples, but I cannot but be impressed by a marked difference in averages.

Take, again, the matter of courage. How many cowards has the recent war provided? Scarcely here and there an individual among the millions of peaceable citizens who have been drafted into an occupation alien to their habits, desperately uncomfortable and infinitely more trying than the sudden shock of an occasional short combat of a few hours. Yet anything approaching this degree of courage was the rare and highly praised exception in the olden days. Disorderly flight among the vanquished, utter loss of either discipline or resolute resistance after a few hours' unsuccessful fighting, was the common result of ancient battles. Such craven cowardice is almost unknown today, and the spirit that has conquered it is no hardiness or toughness of temper, no carelessness of one's life, but, whether flaunted openly or hidden under a veil of modesty, it is the spirit of self-sacrifice for an ideal, hardly even for national benefit, but rather for the good of humanity and of civilization as each side interprets that good.

In another respect the moral improvement that has taken place is more concretely shown. This lies in the restraints and self-control, the breadth of view and fairness of temperament that enable large groups of men to combine and coöperate in business or politics. The success of such organizations, their practicable size and permanency, are measured by the development of these moral qualities in those who enter into them. The political and commercial history of different peoples shows very clearly what were their capacities for organization; and the far greater size, complexity, and permanency of such organizations today in contrast with the small size of the ancient groups, their loose organization and transitory life, indicate pretty clearly the higher stage of moral standards that we have attained. Read the history of the little peoples of Greece, and see how their short-sighted selfishness, tribal vanity, treachery, and cruelty again and again prevented united action, or destroyed the flimsy unions that were formed. See how the Romans, inferior intellectually, prevailed because of their higher capacity for social organization. Note the endless succession of kaleidoscopic shiftings of the loose administrative organisms of the Eastern empires and even of Egypt, although in the last case they were tied to a fixed spot by the isolated and fertile valley of the Nile which provided the material basis upon which they were founded, and gave a partly real, partly apparent permanency to the succession of governments which controlled it.

Contrast with this the relative permanency of modern civilized nations, whose governments have endured, unchanged in essentials, for many centuries: the huge populations which they control, their complexity of organization, their growing reliance upon the law-abiding instincts of the people, upon justice and equity rather than upon force. See how clearly this is correlated with high standards of civilization, how the forms of good government degenerate into corruption, disorder, and military control, and the larger units break up into smaller and looser organizations when entrusted to the hands of inferior races who lack the higher moral or social standards and practice of modern civilized peoples.

One might cite instances and applications without end, but the above will suffice to illustrate the point I wish to make—that while there is no conclusive evidence of intellectual evolution in the human mind since the dawn of history, there would seem to have been a very considerable moral or social evolution—I use the words interchangeably—during that period.

Now all this is exactly what we should expect on the Darwinian theory. Five thousand years, the most that we can give to such historical records as bear upon the present problem, is too short a time, if measured by the recorded rate of progress in evolution, to produce any perceptible change in the physical structure of man. And his intellect, based as it is upon the physical structure and complexity of his brain, should show a similarly slow rate of change. The specialist distinguishes with difficulty between the skull of an extinct horse of the early Pleistocene and that of its modern descendant. Whether we estimate the length of the Pleistocene at 100,000 years or, as high modern authorities insist, at a million or more, it is obvious that the evolutionary change in this race during five thousand years would be imperceptible. And this is equally true of any other race of mammals of which we have a good evolutionary record. By this measure one would not expect to see any appreciable evolutionary change in the brain and intellect of man since history began. On the contrary, if a marked and obvious improvement in brain or other physical characters had taken place during that time, it would constitute an exceptional case of abnormally rapid evolution, calling for explanation.

On the other hand, the moral qualities may be viewed as partaking rather of the nature of fixed habits, viewpoints, instincts, not directly correlated with the complexity of the physical brain structure, and, like other instincts and habits, much more variable and more rapidly modifiable than the physical structures of the body and functions directly dependent upon them.

Natural selection will seize upon those variations which are most useful for the individual or for the race, and will accumulate them in proportion to the rate at which they can be modified. Obviously the moral qualities of man have for many centuries been at least as important for his social advantage as any intellectual or physical superiorities for his individual advantage. Because of their being more rapidly improvable, the principal advance has been in these qualities. Indeed, I find it difficult, as a palæontologist, to look upon human history as other than a splendid record and display of the operation of natural selection applied to races instead of individuals, and resulting in social, not in individual, evolution. This process of social evolution with its rapid changes leading often to an astonishingly elaborate and perfected organization, is by no means confined to man. It is illustrated again and again, in various stages of its development, throughout the animal kingdom. The traces of its existence in extinct races are naturally obscure and difficult to decipher; we are dependent upon observation of living animal societies and inferences as to the evolution of their habits.

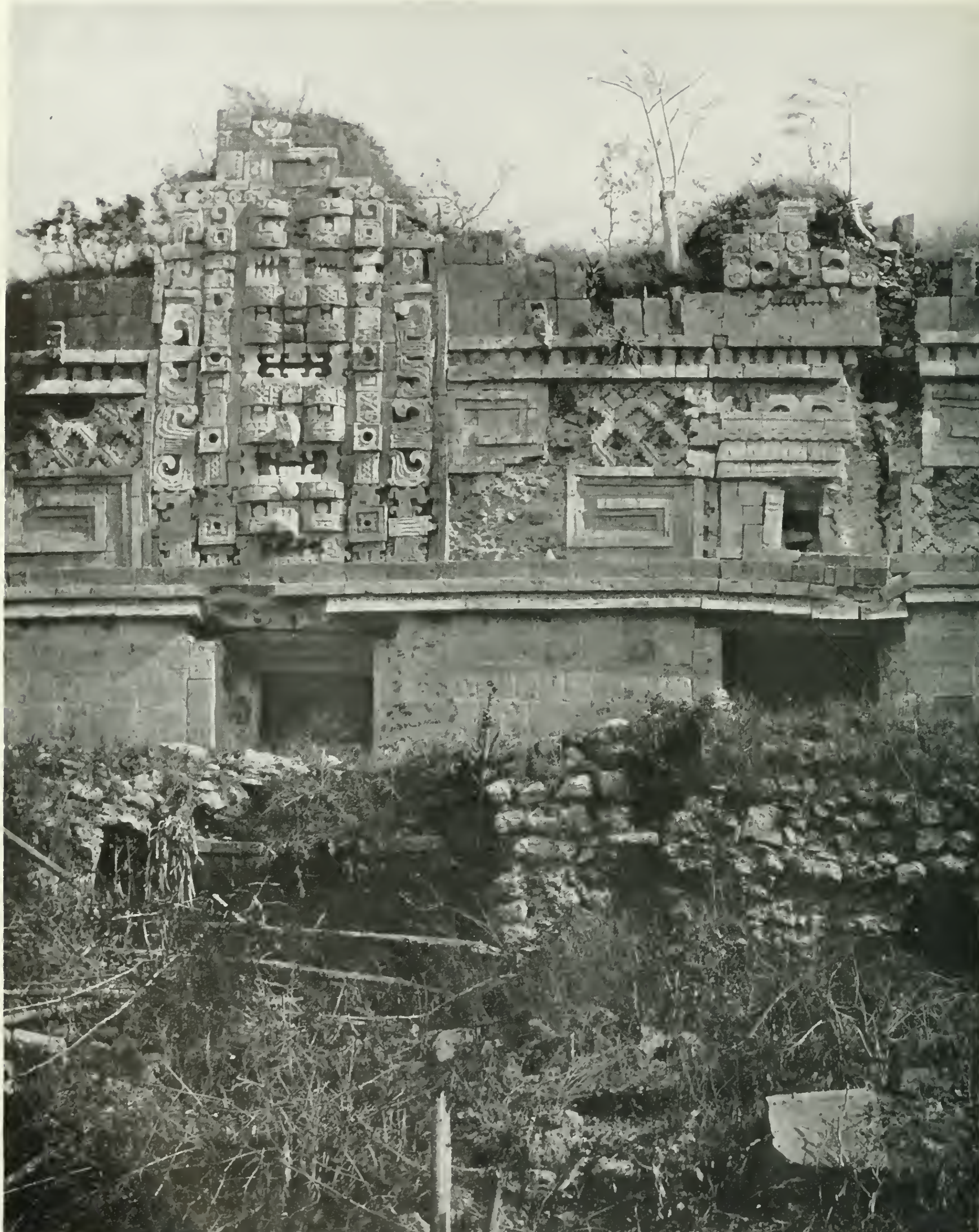
From observation and comparison of such modern social communities, one may perhaps draw certain conclusions as to the trend and limits of social evolution, and apply them to the future of our own race.

(1) Marked tendency to a progressive uniformity and fixity of type and habits. In the early stages of social development one may observe a considerable flexibility and individual initiative, a greater variation in the action of the individual under given conditions. In the more elaborated types of social life the individuals of each class appear to think, act, and feel alike and to perform their respective duties in a more uniform and automatic way.

(2) Although amazingly precise and elaborate social relations are found among lower animals—insects especially—yet the complexity of the community life appears to be limited in many ways by the intelligence of the individual. None of the higher animals has carried social life to the extremes of precision and exact coördination that we observe among the social insects; in none of them is the individual so far sacrificed for the benefit of the race. Yet the complexity of the social life of the higher animals is in some respects greater—in man it is far more complex.

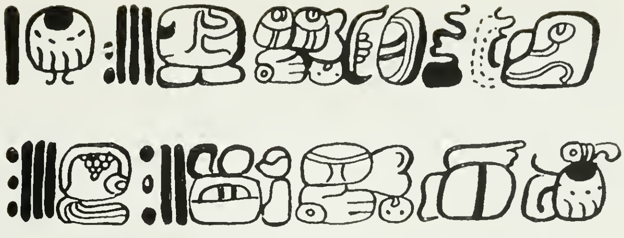
The ultimate result of social evolution would seem to be a precisely adjusted, uniformly acting organization, working with the automatic accuracy of the complex association of cells of which each individual is composed. The degree of complexity which such an organization can attain before it reaches that precise adjustment depends, as I see it, upon the intelligence of the individual units which compose it.

If this be true, we must conclude that once such a finished social mechanism has been perfected, its further progress must be relatively slow. While up to this stage its evolution has depended upon the modifying and perfecting of the moral or social instincts, henceforth it must depend upon the far slower evolution of a higher physical and intellectual type. From the short perspective of human history this phase of physical and intellectual evolution is so slow as to be negligible. We may fairly say that our present trend of social evolution will tend to advance to a civilization far more complex, far more precise in its adjustment, to continually more uniform group-types of individuals, not appreciably higher in intellect but very much higher in morality; to eliminate more and more completely the criminal, the idle, the selfish individual, the unsocial of every type; and to reach finally the goal of altruistic endeavor. This cannot be reached, however, in a generation; such a mechanism involves much higher standards of morality than now exist in the average man, and requires also the elimination of all who fail to measure up to them. But that this process is going on, and has been going on for some thousands of years, I, who read history in the light of palæontology and evolution, cannot doubt. Nor have I any doubt as to its ultimate outcome, regrettable in some respects, desirable in many others, to the individual who, with growing social instincts, still retains some of the flexibility and impatience of restraint and uniformity that are inherited from his remote forebears of the wild tribes of primitive man. But what will be, will be. We may try to read the future if we will; we cannot alter it.



A DETAIL OF THE NUNNERY AT UXMAL

The stone faces of forgotten gods, placed one above the other in panels of richest ornament, look out from the walls of ancient Yucatan buildings. The decoration between the panels is scarcely less extravagant. We see great frets applied in fashions that the Greeks never thought of, latticework, and, at intervals, little temples in low relief, with roofs of serpents and feathers, above niches in which gods were seated cross-legged. This picture is a detail of the north range of the Quadrangle of the Nunnery at Uxmal



An illustration of the Mayan system of recording time. From an inscription painted on the capstone of a vaulted chamber in one of the buildings of the Nunnery Quadrangle. The date *5 Ymix 19 Kankin* at Uxmal is presumably that of 1219 A.D. See description on page 382

The Stephens Sculptures from Yucatan

By HERBERT J. SPINDEN

Assistant Curator of Anthropology in the American Museum

IN some old library on a gloomy day have you ever found as treasure trove the wonderful volumes of travel in which John L. Stephens describes the ruined cities of Central America which he was the first to explore? The four volumes, covering two expeditions in 1839 and 1841, are filled with steel engravings slightly foxed with time and dampness, even in the best copies. The engravings were made from the camera lucida drawings of Francis Catherwood, corrected by some of the earliest daguerreotype photographs, and they portray faithfully the monuments of Copan and the ruined temples and palaces of Palenque, Uxmal, Kabah, Labna, Chichen Itza, and numerous other sites of the ancient Mayan civilization. The narrative gives the facts of archæological interest, as well as a moving picture of native life and the vicissitudes of travel.

Few persons know that choice examples of Mayan art brought from Yucatan by Stephens have been kept for eighty years on an island halfway up the Hudson. These sculptures are now harbored in the American Museum of Natural History where they have been prepared for exhibition.

John Lloyd Stephens was a traveler, a writer of books, and an organizer of steamship lines and railroads. Born in 1805 and graduated from Columbia University, he first sprang into prominence because of travel letters sent back from the Near East to a New York magazine. In 1837 he published two volumes entitled *Incidents of Travel in Egypt, Arabia Petræa, and the Holy Land*, that are chiefly noteworthy today for their early descriptions of Petra, the city on the crossroads of Arabia where the temples are carved out of the cliffs. In 1838 he published two additional volumes, *Incidents of Travel in Greece, Turkey, Russia, and Poland.* These books passed through many editions in the United States and England.

In 1839 Stephens was sent by President Van Buren to negotiate a treaty with the Central American Republic, but this was then disintegrating into the present five republics and Stephens was unable to accomplish his mission. He did, however, carry his explorations far afield and brought forcibly to the attention of the world the remarkable ruins of ancient America, in his two volumes published in 1841, called *Incidents of Travel in Central America, Chiapas, and Yucatan.* He made a second trip to Yucatan for more careful and more detailed study and in 1843 published his last two volumes, *Incidents of Travel in Yucatan.*

This fine grotesque from the Quadrangle of the Nunnery at Uxmal is made up of several stones carefully mortised together by the pin and dowel method. The face is covered with a mask of turquoise (made of little pieces of turquoise carefully fitted together with other bright stones and bits of shell over a wooden base). It probably is intended to represent one of the gods. Four of the heads are still in position on the façade of one of the buildings at Uxmal (see page 383), while two heads (of which this is one) have fallen away or been removed

In those days travel in tropical America was attended with grave danger to health, because quinine was as yet unknown as a specific for the deadly malaria. Stephens greatly impaired his strength in these researches. For a number of years afterward he resided in New York, organizing the first steamship line between New York and Bremen. Then, with the discovery of gold in California and the necessity of transit across the Isthmus of Panama, he organized the Panama Railroad, being vice president and then president of the company. He went to Bogota and negotiated a concession for this railroad in 1849, and battled with fevers while personally managing the work of building the road. He died in 1852, a martyr to enterprise in the tropics. A statue of him stands in the Canal Zone; there is also a fine memorial window in his honor in the old Church of St. George on Sixteenth Street in New York City.

The collection of choice pieces of

carved wood and pottery that Stephens and Catherwood brought back with them was destroyed by the burning of a panoramic exhibition that Catherwood had arranged in New York. This panoramic exhibition showed the glories of ancient civilizations and bonded Egypt and Central America. The only specimens of Stephens' collection which were not destroyed at this time were the stone sculptures which fortunately had not yet arrived in New York by ship from Yucatan. These were later given by Stephens to John Church Cruger, of Cruger's Island, and now from the estate of Mr. Cruger's daughters they have passed into the possession of the American Museum of Natural History.

Cruger's Island is a wooded, rocky island in the Hudson near the station of Barrytown, opposite the Catskills. It was originally called Magdalen Island, and was bought from the Indians in 1688 by Colonel Peter Schuyler. Later, John Church Cruger, the great-nephew of Colonel Schuyler, built a mansion on this island, and on a rocky hill at its southern extremity made settings for the Mayan sculptures in the walls and broken arches of an imitation of a ruined church. Here the carved blocks of gray limestone from Yucatan showed in startling contrast against the dark background of lichened slabs from the native ledges.

Stephens in his last books laments the loss of a carved lintel beam of sapote wood from Uxmal as well as other specimens destroyed by the conflagration in New York. I quote his narrative[1] since it makes reference to the pieces now in the Museum:

> It was ten feet long, one foot nine inches broad, and ten inches thick, of Sapote wood, enormously heavy and unwieldy. To keep the sculptured side from being chafed and broken, I had it covered with costal or hemp bagging, and stuffed with dry grass to the thickness of six inches. It left Uxmal on the shoulders of ten Indians, after many vicissitudes reached this city uninjured, and was deposited in Mr. Catherwood's Panorama. I had referred to it as being in the National Museum at Washington, whither I intended to send it as soon as a collection of large sculptured stones, which I was obliged to leave behind, should arrive; but on the burning of that building, in the general conflagration of Jerusalem and Thebes, this part of Uxmal was consumed, and with it other beams afterward discovered, much more curious and interesting; as also the whole collection of vases, figures, idols, and other relics gathered upon this journey. The collecting, packing, and transporting of these things had given me more trouble and annoyance than any other circumstance in our journey, and their loss cannot be replaced; for, being first on the ground, and having all at my choice, I of course selected only those objects which were most curious and valuable; and if I were to go over the whole ground again, I could not find others equal to them. I had the melancholy satisfaction of seeing their ashes exactly as the fire had left them. We seemed doomed to be in the midst of ruins; but in all our explorations there was none so touching as this.

In the collection preserved by late arrival that now forms a fitting memorial to John L. Stephens, there are several fine sculptures from Uxmal. One of these comes from the western façade of the eastern building of the Nunnery Quadrangle. This particular façade is one of the most famous in the Mayan area. It is given in its full extent in an accompanying view, with the Temple of the Magician towering in the background. It served as a basis for the now discarded theory of Viollet-le-Duc that Mayan architectural decoration represents a survival in stone of a system of log cribbing and lattice-work. The central door is surmounted by three grotesque faces or mask panels, and similar ones in vertical series are bent around each of the corners. In the long sections between these mask panels are six ornamental constructions which certainly resemble cribwork of logs over a background of

[1] *Incidents of Travel in Yucatan*, Vol. I, p. 179.

latticework, and in the center of each of these is a grotesque head representing a face covered with a mask of turquoise mosaic and surmounted by a headdress of feathers. The central portion of this sculpture was supported in the wall by a long tenon at the back. Several separate pieces, forming parts of the headdress, were skillfully attached to the centerpiece by dowels and dowel pins. It is possible that the crevices in this composite ornament were filled in with plaster, and that the whole was painted in bright colors.

The Nunnery Quadrangle at Uxmal is a fine example of Mayan architecture of the Second Empire. In one of the buildings is an inscription painted on the capstone of a vaulted chamber and containing a date in the Mayan system of recording time. This inscription is given herewith (see page 379). The significant hieroglyphs are the first two in each line: in the upper line is recorded the day *5 Ymix, 19 Kankin*, and in the second line we read *18 Tuns, 13 Katuns*. In other words, this inscription records a day *Ymix* with the number *5*, which occurred before the completion of a *Tun 18* and a *Katun 13*. In the long count of the first empire this date equals 11.12.17.11.1. According to the most generally accepted correlation this date occurred in the year 1219 A.D.

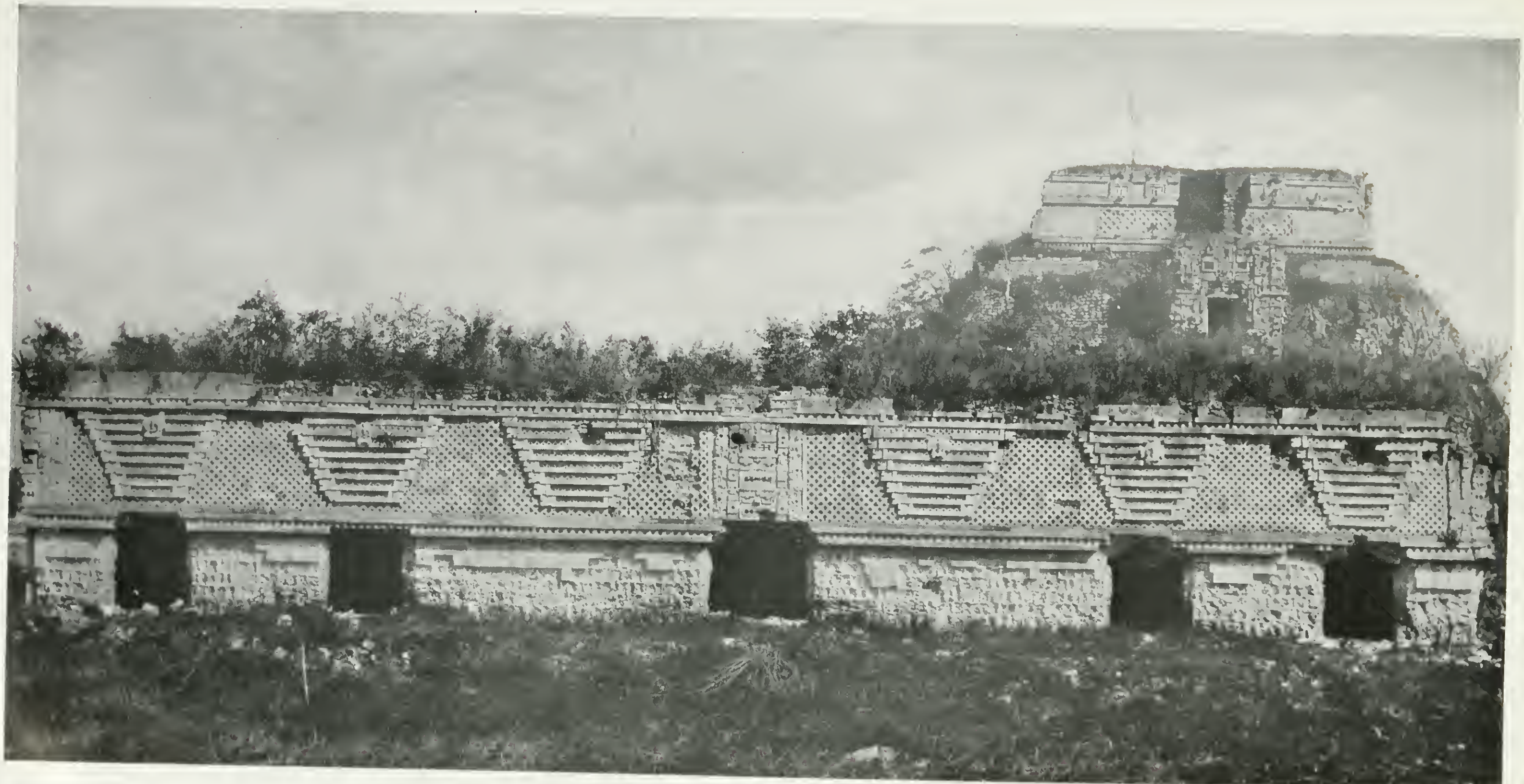
One of the pieces in the present collection—a portion of a headdress showing a fine series of plumes rising from a death's head—is figured in connection with Stephens' first description of the House of the Governor.[1] I quote his description of this famous building:

> On this third terrace, with its principal doorway facing the range of steps, stands the noble structure of the Casa del Gobernador. The façade measures three hundred and twenty feet. Away from the region of dreadful rains, and the rank growth of forest which smothers the ruins of Palenque, it stands with all its walls erect, and almost as perfect as when deserted by its inhabitants. The whole building is of stone, plain up to the moulding that runs along the tops of the doorway, and above filled with the same rich, strange, and elaborate sculpture, among which is particularly conspicuous the ornament before referred to as la grecque. There is no rudeness or barbarity in the design or proportions; on the contrary, the whole wears an air of architectural symmetry and grandeur; and as the stranger ascends the steps and casts a bewildered eye along its open and desolate doors, it is hard to believe that he sees before him the work of a race in whose epitaph, as written by historians, they are called ignorant of art, and said to have perished in the rudeness of savage life. If it stood at this day on its grand artificial terrace in Hyde Park or the Garden of the Tuileries, it would form a new order, I do not say equaling, but not unworthy to stand side by side with the remains of Egyptian, Grecian, and Roman art.

[1] *Incidents of Travel in Central America, Chiapas, and Yucatan*, Vol. II, p. 429.

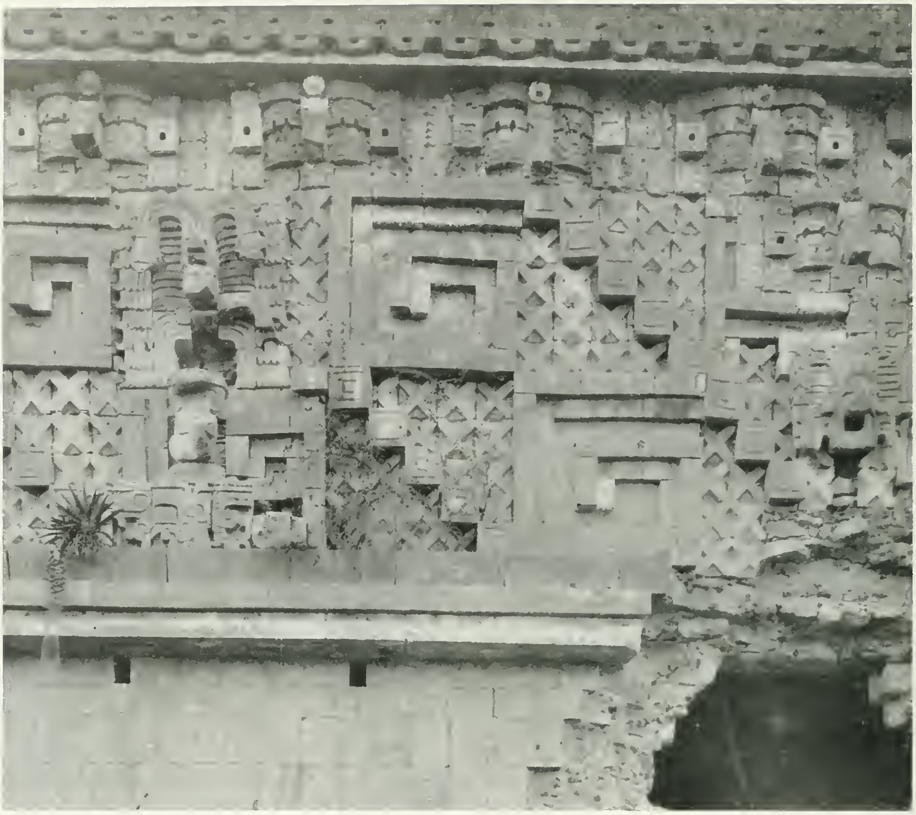
Several other pieces also come from the House of the Governor, and form parts of complicated ornaments built up out of separately carved blocks of stone. The subject is a human being with enormous headdress seated over the open jaws of a conventionalized serpent. Fortunately, a similar sculpture is still in place (see illustration on page 384), and in this case the open serpent jaws at the bottom of the decorated zone overlie a background of frets and latticework. Upon these jaws rests a round stool on which a human figure is seated. But the legs and arms that formerly extended out from the wall of the building have been broken off and the face greatly damaged. The headdress is lofty, and from it proceed enormous bunches of feathers which divide at the top and fall symmetrically on either side.

The fragments now in the American Museum show the stool, the broken figure (page 385), and sections of headdress which cannot be satisfactorily pieced together. As in the case



IN THE ANCIENT MAYAN CITY OF UXMAL

This view of the East Range of the Nunnery Quadrangle, with the House of the Magician on its lofty pyramid in the background, is a justly famous one in the ancient Mayan city of Uxmal. The grotesque face (see page 380), wearing a turquoise mask and made up of several separately carved stones, comes from this façade. It will be observed that there are places for six such faces in the central positions on the decorative devices that resemble cribwork, and that four of them are in position. The built-up head with headdress in the Stephens collection may contain parts from the other two heads, especially since some of the joints do not fit properly



This detail of the House of the Governor at Uxmal shows clearly that the rich façade decorations are made by an incrustation of separately carved stones. The frets are three in one, each on a different plane, the lattice background is formed by square stones, each with a cross; the grotesque faces are likewise built up of parts. At the observer's left are the remains of a human or divine figure with great headdress of feathers, seated over the open mouth of a highly conventionalized serpent (if the reader will take the writer's word for it!). The battered figure that Stephens brought back and the parts of the feather headdress belong to such an assemblage as we see here

of the sculptures already described, the larger blocks were set into the wall of the building by long tenons (see illustration on page 387) while smaller blocks were attached to these by the device of the dowel pin. The material is a hard, blue-gray limestone which weathers well.

At Kabah, a ruin deriving much of its fame from a building entirely covered with great stone faces, Stephens discovered a small temple with sculptured door jambs and another temple with a finely carved lintel of sapote wood. This lintel was among the pieces destroyed by the conflagration. The stone door jambs were also excavated and form the most remarkable specimens in the Stephens collection. The original account[1] of the discovery follows:

Beyond this was another building, so unpretending in its appearance compared with the first, that, but for the uncertainty in regard to what might be found in every part of these ruins, I should hardly have noticed it. This building had but one doorway, which was nearly choked up; but on passing into it I noticed sculptured on the jambs, nearly buried, a protruding corner of a plume of feathers. This I immediately supposed to be a headdress, and that below was a sculptured human figure. This, again, was entirely new. The jambs of all the doors we had hitherto seen were plain. By closer inspection I found on the opposite jamb a cor-

[1] *Incidents of Travel in Yucatan,* Vol. I, p. 411

responding stone, but entirely buried. The top stone of both was missing, but I found them near by, and determined immediately to excavate the parts that were buried, and carry the whole away; but it was a more difficult business than that of getting out the beams. A solid mound of earth descended from the outside to the back wall of the apartment, choking the doorway to within a few feet of the top. To clear the whole doorway was out of the question, for the Indians had only their hands with which to scoop out the accumulated mass. The only way was to dig down beside each stone, then separate it from the wall with the crowbar, and pry it out. I was engaged in this work two entire days, and on the second the Indians wanted to abandon it. They had dug down nearly to the bottom, and one man in the hole refused to work any longer. To keep them together and not lose another day, I was obliged to labour myself; and late in the afternoon we got out the stones, with poles for levers, lifted them over the mound, and set them up against the back wall.

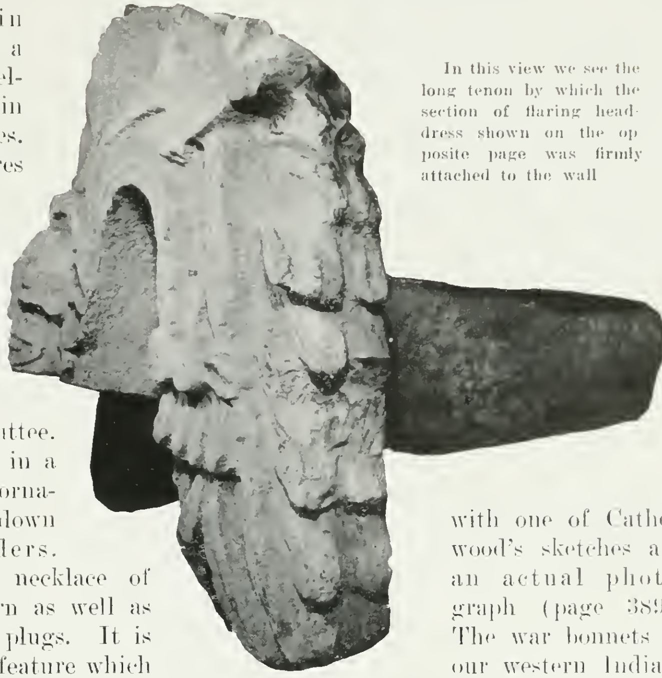
The plates opposite represent these two jambs as they stood facing each other in the doorway. Each consists of two separate stones, as indicated in the engravings. In each the upper stone is one foot five inches high, and the lower one four feet six inches, and both are two feet three inches wide. The subject consists of two figures, one standing, and the other kneeling before him. Both have unnatural and grotesque faces, probably containing some symbolical meaning. The headdress is a lofty plume of feathers, falling to the heels of the standing figure; and under his feet is a row of hieroglyphics.

The drawings of Catherwood which, in Stephens' book, accompany the descriptions just given are not up to his usual standard and seem to have been hastily made (see drawing at the left on page 389). Nevertheless, they have permitted the restoration of the top portion of one of the jambs, which has been lost. The sculpture is in flat relief and, in each case, represents, first, a standing warrior with an enormous feather headdress that rises far above the head and falls to the ground at the back. Secondly, there is a figure in suppliant pose, that may represent a common warrior before his commander, or some vanquished chief before his captor. The kneeling warrior hypothesis is the more likely in view of the fact that in one case the kneeling figure holds aloft a battle-ax made of four stone knives set in a club, while in the other case he apparently holds up the

This battered and broken human figure formed part of the façade decoration of the House of the Governor at Uxmal. A similar piece with wide-spreading headdress, carved on several stones, is still in position. Here the bottom drum represents a kind of chair or stool. The legs of the human figure formerly passed down in front of this seat

Section of an elaborate headdress of a human figure, employed in architectural decoration. The central part of the sculpture represents a skull

Another section of a headdress. The great feather headdresses were intended to fit one over the other. Note the free and graceful use of feathers



In this view we see the long tenon by which the section of flaring headdress shown on the opposite page was firmly attached to the wall

so-called manikin scepter, which is a ceremonial object seldom if ever shown in the hands of captives.

The larger figures are characterized by a slenderness seldom seen in Mayan sculptures. On the feet are sandals; below the knee, the legs are wrapped with a kind of spiral puttee. The body is clothed in a breechcloth while ornamental strips hang down from the shoulders. Wristbands and a necklace of stone beads are worn as well as ear plugs and nose plugs. It is this last mentioned feature which is responsible for the long, grotesque noses of the Catherwood drawings. The headdress is a boxlike bonnet covered with a surfacing of fine feathers (which we can imagine represents regalia of the most brilliant coloring). From the top of this bonnet rises a fountain of quetzal plumes sweeping to the front and to the back. The detail of one of these remarkable door jambs is admirably brought out in the fine drawing made by Mr. John Held, Jr., which is shown in combination with one of Catherwood's sketches and an actual photograph (page 389). The war bonnets of our western Indians pale into insignificance before such a gallant costume as this, for the long, flexible plumes of the quetzal are a most brilliant green, and we can imagine this color was set off by touches of crimson and gold.

There is a narrow line of hieroglyphs under the feet of these figures, but unfortunately no dates that can be deciphered. Through their general characteristics we may place these sculptures in the eleventh or twelfth century A.D.

RECORDING AN INTERVAL OF NEARLY EIGHTY YEARS

A camera lucida enabled Francis Catherwood to make drawings of great accuracy during his journeys with Stephens. At the left is shown a grotesque head at the ancient city of Copan in Honduras, drawn by Catherwood in 1840, while at the right is a photograph of the same object made by the writer in 1917

ORIGINAL SCULPTURE, WITH PEN STUDIES

The three illustrations placed here side by side represent a sculptured door jamb from a small temple at Kabah. The one on the left is a rough sketch made on the spot by Francis Catherwood in 1840. Since the stones were to come to the United States, he did not consider it necessary to make a finished drawing. The illustration in the middle is an actual photograph of the sculpture in the American Museum, after it had been mended and prepared for exhibition. At the right we have a recent drawing by Mr John Held, Jr., restoring many of the details according to original design. Mr. Held, when at Kabah, not knowing the stones had been removed, made an extensive search for them, since Stephens nowhere says specifically that he took them away from the ruined city

AFTER THE ERUPTION OF KATMAI, ALASKA[1]

THE STORY OF THE EFFECT ON CULTIVATED AND NATIVE VEGETATION

BY ROBERT F. GRIGGS

Assistant Professor of Botany, Ohio State University; Director of the Katmai Expeditions of 1915–16–17–18–19 for the National Geographic Society

Photograph by M. D. Snodgrass

A LAND BURIED UNDER VOLCANIC ASH

At the end of the first growing season after the eruption, October, 1912

The volcanic eruption of Mount Katmai in southern Alaska in June, 1912, buried the surrounding region under a volume of ash and pumice estimated at 4.9 cubic miles. This picture was taken near the town of Kodiak on the island of the same name, one hundred miles from the volcano. Even at that distance the volcanic ejecta covered the ground to a depth of nearly a foot. Only the spruce forests held their heads above the general desolation, almost all other plants having been completely covered over.

This widespread destruction of plant life has provided opportunity for an extensive study of the problem of revegetation, a task which was undertaken by Dr. R. F. Griggs for the National Geographic Society. On Kodiak the problem was solved by renewed growth on the part of the original plants after a protracted period of dormancy, but throughout the continental areas, where nearly every living thing was killed, the rehabilitation of the flora has gone on most slowly from wind- and water-borne seeds. During the first two years the gray-brown slopes of the island of Kodiak remained much as they were immediately after the eruption, and the barrenness was relieved by only an occasional willow or alder top which stuck through the ash and by sparse patches of strong-stemmed perennials such as lupines and fireweeds. Not until the third growing season was there any marked change; then the long buried perennials suddenly burst forth, covering hillside and valley with their original verdure

Photograph by Robert F. Griggs

THROUGH THE ASH

The horsetail (*Equisetum arvense*) forced its way through great depths of ash. It proved the most important plant for providing cover over the deeply buried continental areas. Observations on its growth in gullies where the surrounding deposits were too thick to be penetrated, showed that it could push through three feet of ash. The horsetail is especially adapted for occupying extensive areas which otherwise would become shifting dunes. Its propagation is by perennial underground runners; it has pointed branches with scaly, teeth-like leaves which readily grow upward toward the light when completely buried, and it is sheathed in a hard epidermal coat of silicified cells which admirably protects it against wind-blown sand.

The trees of this continental region, as may be noted in the picture, are dead, although they were not overcome by the pumice shower. Presumably their leaves and buds were killed by a hot blast during the eruption, and the roots subsequently starved to death. Such hot blasts, sometimes of tornadic violence, are not uncommon in severe eruptions, and destroy every living thing.

The destruction of antecedent vegetation in the very deeply buried region around Mount Katmai itself was so complete that revegetation by wind- and water-borne seeds has been and will continue to be a slow process indeed, and here the problems of rehabilitation may be worked out in detail. The lupines are the most important pioneers, not only because of their large, heavy seeds which find lodgment when other seeds are blown away, but also because of their ability to utilize atmospheric nitrogen. In very sheltered spots other seeds have sprouted, especially those of the willow, which will probably form the pioneer growth over considerable areas. Out beyond the territory reached by the hot blast and destructive ash shower, rains acidulated by the volcanic fumes (sulphuric acid) did considerable though not permanent damage, destroying the season's crops

Photograph by D. B. Church

On Kodiak and in other places where the ash was not too deep the old roots began to send up new shoots during the second year. By the third growing season the mountains around Kodiak were everywhere green with a lush growth such as had never before been seen on the island. The grass which came up, chiefly the native "blue top" (*Calamagrostis langsdorfi*), penetrated twenty inches of ash in some places. This improvement of the pastures is not to be attributed to any fertilizing effect on the part of the volcanic deposit, which of itself forms a very poor soil, but rather to its action as a mulch, smothering the smaller herbs and so creating better growing conditions for the stronger grass. The ash also improved the physical condition of the soil, which was formerly heavy and mucky

Photograph by Robert F. Griggs

In sharp contrast with the luxuriant growth of old vegetation (photograph above).—This plot of timothy was sown in the untreated ash at the Government Experimental Farm at Kalsin Bay soon after the eruption. The seedlings came up well and were still alive after four years of growth but attained a stature of only three inches. The ash as a supporter of growth proved little better than sterile quartz sand. Where nitrogenous fertilizers were added to the deposits, a fair crop was harvested the first year but could not be duplicated a second season, for the ash required a complete fertilizer. Its infertility contrasts strongly with the fertility of soil derived from the slow weathering of volcanic lava such as underlies the great farming regions of Oregon, Washington, and Idaho

Photograph by B. B. Fulton

EFFECT ON AREAS CULTIVATED AND FALLOW BEFORE THE ERUPTION

The important part played by the old vegetation in contrast with seedlings is apparent in this picture of a plowed field (at the left) near Kodiak. Cultivation just before the eruption destroyed the weeds; four years later the plowed land was still a barren waste with a clear line of demarkation between it and the area (at the right) covered with residual vegetation. The fine ash deposited on the previously cultivated plot was kept moving by the wind so that few seedlings could find a sheltered spot. Wind and water are, however, rapidly removing the ash altogether, so that where the deposits were not more than a foot thick, the original soil is now being exposed. The effects of wind and water are particularly evident on the mountains, from which a large part of the ash will have been blown out to sea within a few years, leaving the grasses and lupines to start the slow task of rehabilitating the alpine heath which was almost completely destroyed. The lowly alpine plants were unable to penetrate the heavy blanket of ash which so long covered them

Photograph by D. B. Church

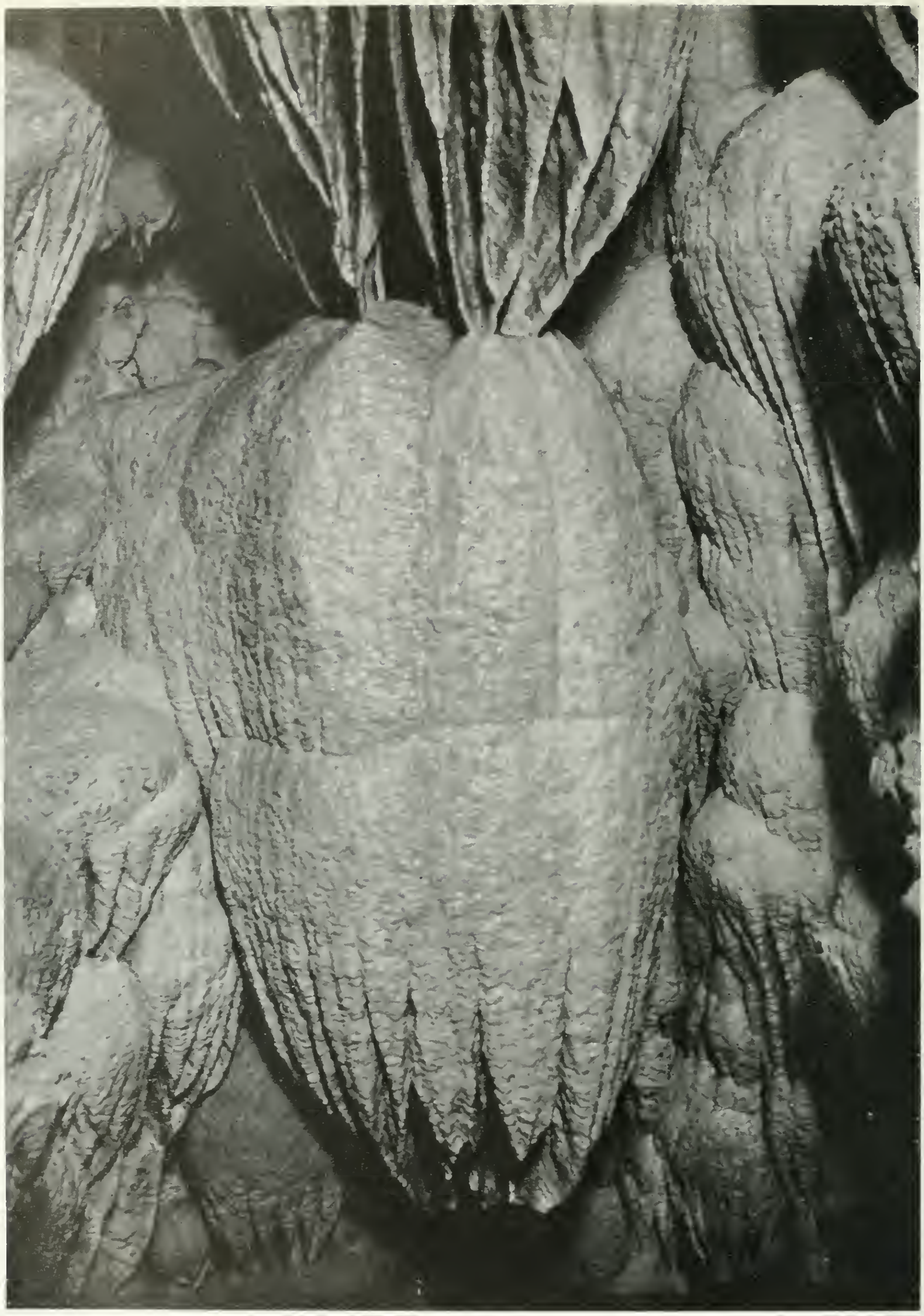
SHIFTING DUNES OF ASH

The resuscitated plant life was invaluable as an agent for binding down the ash and protecting the surface of the ground, for wherever there were no plants, the wind quickly picked up the loose pumice, driving it in destructive blasts or piling it into even more destructive dunes. At the right in the photograph is seen a dune of wind-blown ash near Kodiak. Although it is partly overgrown on top, its shifting sides provide an inhospitable foothold for seeds. At the left the protective action of the forests is well illustrated. The trees shielded the ground from the wind and increased the humidity of the air, permitting seedlings to take root

Photograph by Robert F. Griggs

HARDY PLANTS WHICH FINALLY SUCCUMBED

The abrasive power of the particles of ash, which are lighter and more angular than those of shore sand, lopped over and cut to pieces the weeds. It tore the bark from the trees and even ate into their wood. Wherever plants stood in groups, the ash lodged behind them like drifts of snow several feet deep. The resultant accumulation resembled the shifting white dunes of the seashore, for the more rapidly the plants grew out the more sand they collected, until finally a hill was formed or the growing vegetation was engulfed. The willows, which could readily send out new roots at any level, maintained themselves fairly well, but such plants as the fireweed (*Chamaenerion angustifolium*), shown in the photograph, were soon so deeply buried that their conducting system could no longer maintain connection between leaves and roots



"THE PRIDE OF THE CAVES"

The walls of the Oregon Caves are embellished with glistening crystalline limestone.—often with graceful traceries in delicate or bold relief of what seem flower and fruit designs. No one can gain even a small idea of the beauty of the caves without seeing them. Photographs give only the form of these decorations, nothing of the color or finish.

The Oregon Caves were discovered in 1874 by a hunter, Mr. Elijah Davidson, who still lives near by; and since 1909 they have become a much frequented national monument of the United States. They are made up of a succession of marvelously beautiful underground halls with irregular connecting corridors and galleries. Like other limestone caves these have been formed by the erosive and solvent action of water charged with carbon dioxide. The rock dissolved away and the channels were enlarged and extended by underground streams (probably during the Glacial period). Then in turn redeposition of lime carbonate has been slowly effected by saturated waters percolating from above. In this way the spectacular stalactites and stalagmites of the Oregon Caves have been molded and the successive crystalline coatings laid down on the walls and floors

Here the dead, shining columns, like spectral trees, have given the name, "Petrified Forest"

The Oregon Caves[1]

REMARKABLE "MARBLE HALLS" OF JOSEPHINE COUNTY

By IRA A. WILLIAMS

Geologist, Oregon Bureau of Mines and Geology

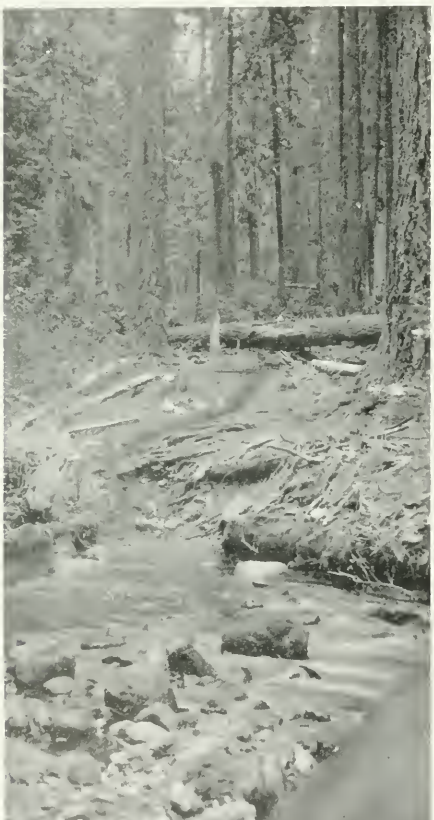
NEAR the southwest corner of Oregon in the rugged hills of the Coast Range is a much frequented national monument, the Oregon Caves. Joaquin Miller some years ago designated this great series of then only partly explored caverns, "the marble halls of Oregon," and they are generally known by that name at the present time. The appropriateness of this title promptly appeals to every one who visits these caves, for they are, in reality, a glorious succession of halls, and these halls, as well as the connecting corridors and avenues, galleries and chambers, are of glittering white marble.

This monument is located near the west edge of Josephine County, Oregon, which is separated from the Pacific Ocean by Curry County, whose coast line is forty miles to the westward. It is less than seven miles from the Oregon-California line, at an alti-

[1] The presidential proclamation which withdrew the Oregon Caves from private ownership and established them as a national monument is dated July 12, 1909. The monument is administered by the United States Department of Agriculture, and since it is in the Siskiyou National Forest, comes under the jurisdiction of the Forest Service branch of that department. In keeping with sound national policy, reasonable expenditures have been made in each of the last several years, and are still being made, to render this natural wonder accessible to the world. An excellent trail now reaches it from Williams Creek ten miles to the northeast, where there is a suitably equipped summer camp station conveniently reached by automobile over a twenty-seven-mile stretch of fair road from Grants Pass, which is on the main line of the Southern Pacific Railroad. From the west and the head of automobile travel there, five miles of trail bring one to the caves by way of the Grants Pass-Crescent City (California) Highway. Plans are now under way for building an automobile thoroughfare direct to the main entrance of the caves, a project to be most highly commended and encouraged, and an entirely feasible one, it would seem, as forest and mountain road construction goes.

tude of approximately four thousand feet above the sea. Prior to discovery its entrance was doubtless concealed for centuries within the shadows of the sturdy firs and western hemlocks, which, with the celebrated Port Orford cedar and Sitka spruce, chiefly clothe the slopes of the Oregon Coast Range and the summit heights of the connecting range, the Siskiyou Mountains.

Because of its location in Josephine County, the Oregon Caves were long called locally and in the literature,



The trail to the Oregon Caves.—Prior to the discovery of the caves, less than fifty years ago, the main entrance had lain hidden among the firs and spruces of the Siskiyou forest. Even today the caves are thirty-seven miles from the nearest railway station (Southern Pacific). A good road, however, covers the first twenty-seven miles and from the end of the road the United States Forest Service has cut a trail. A project is now under way to build an automobile highway directly to the entrance

"Josephine Caves." Their discovery dates back to August 6, 1874, when, it is related, Mr. Elijah Davidson (who still lives near by in the valley of the Applegate River) in pursuit of a bear came to the lower entrance, in the darkness of which the wounded beast had taken refuge. The history of the exploration of the caves will probably never be written in detail, although it would appear to be one in which fortunately unsuccessful attempts at commercial exploitation have had an ignoble part. Nor do we need to be told that the caves were frequented for years before the protecting hand of the Government was extended in order that they might be preserved for all time; for the infallible mark of the careless person is there, the one who, when not under surveillance, forgets that nature builds not for him alone, and that he should not mar, or maliciously destroy, some of her most beautiful creations.

The Oregon Caves are representative of a type of underground cavern by which limestone formations are characterized the world over. The geologist would explain that marble is only a limestone that has become hardened and crystallized by the action of those agents in the shell of the earth—heat, pressure, and circulating water—that modify the physical condition of rocks everywhere. Caves are formed in rocks whose substance is relatively easily dissolved away. Limestone is the most common one of these, and marble, which is but a crystalline limestone, shares this same susceptibility to the solvent action of earth waters.

The best known limestone caves of the world are sources of wonder because of their great size and the intricate and extensive ramifications of the underground openings. Streams of water flow through some of them, and sightless fish and other forms of life that are born of darkness inhabit them. In contrast, the Oregon Caves are a series of relatively small, often narrow passageways largely of extreme irregularity in shape. With the exception of entrancing little Cave Creek which issues from the lower opening, the explored parts are free from running water, while of cave life none is known to exist. But it is the fortunate absence of running water and the relatively small size, that have permitted nature to spread with extravagantly lavish hand everywhere within these caves the most elaborate of decorations. Crystalline embellishment is upon the floors, pendent from the ceilings, and tastefully molded against the walls, so that rarely does a point of uncovered rock show through. Stalactites and stalagmites reach toward each other, one from above, the other from below. In places they join as though to form supporting columns. Festoons of spectacularly ornate pattern cling to projecting ledges, while again there is the most delicate of rock-fretted tracery to please the artistic eye.

And what is the story of the formation of these caves with their distinctive and bewilderingly ornamental features? It is indeed a short one to relate, although it tells of a series of events—geologic events, 'tis true—some of which, as human passions are moved, possess a tinge of romance, others of tragedy. Limestones are a common variety of rock in nature and are known to be formed under conditions that obtain in the depths of the ocean. They are now found as a part of land surfaces because earth movements have carried them into positions above the level of ocean waters. During the process of their accumulation, and later during their elevation above the sea, their substance became compacted and hardened into a firm rock. It rarely happens that uplifting forces act so gently and so uniformly as not to disturb seriously rock layers that are involved in the movement. The beds are subjected to both compression and tension, and become curved or twisted, bent, kinked, and frequently rent apart and broken. When the disturbance is sufficiently intense the nature of the rock material itself becomes so changed that in some instances the original character may be scarcely recognizable.

Just so has it been with the body of marble in which the Oregon Caves are found. Originally a granular lime-

The Oregon Caves honeycomb the structure of a great body of marbleized limestone which is in the northwest slope of Grayback Mountain, a peak whose summit is more than 7000 feet above the sea. There are two entrances; this, the lower, lies at about 4000 feet altitude stone, it is now a beautifully mottled grayish white marble, in appearance no different from many architectural marbles that lend gentility of character to the structure or finish of enduring buildings everywhere. What may have been we know not how extensive a body of limestone at one time, is now a comparatively narrow belt of marble tilted up on edge and squeezed into elongated lenticular form. It is pinched in between other rocks, some of which were once clays but now are so completely transformed as to bear little resemblance to that plebeian substance.

It would seem that a rock with even the reputed stability of marble could scarcely be expected to withstand such vigorous treatment without showing at least some signs of reaching its limitations. And the most unmistakable evidence that is present are the occasional crevices which traverse the face of almost all the outstanding marble cliffs, of which there are a plenty in the region. The marble gave way to the strains of uplift, and found relief in the opening up of cracks and fissures which today are the characters by which we decipher the exigencies of its past history.

Far more than with the distant past, however, have these cracks and crevices had to do with the events of more recent days in which our interest now centers. Doubtless most of them were small when formed, many of them so minute as to be scarcely discernible. But small and great, they became from the very first the natural lines of easiest movement for the underground waters that are ever present and in motion, seeking out their level beneath the ground, just as waters do upon the land surface. Percolation through the pores of soils and of all rocks is the normal movement of ground waters. If these pores enlarge into cracks, or, better yet, if the substance of the rock dissolves by the action of the water itself, cells or cavities or even tunnels result. That is precisely what took place in our bed of marble, and at once openings of any size came into being, more and more of the circulating waters were attracted, until subterranean streams became established. Streams beneath the ground perform work just as do surface streams. Once a beginning is made, they erode their channels and enlarge their valleys to the limit of their ability as determined by volume of water and by gradient. At the same time percolation in and dissolving of the surrounding rock walls continue until rooms are formed, and the rock becomes honeycombed, or, in the extreme case, the structure breaks down entirely.

There is no alternative but to conceive that such a series of events at the outset produced the openings that finally gave us the Oregon Caves. Solution of rock substance started these openings; subterranean streams assisted to enlarge them and to carry away both eroded and dissolved materials. In order for this process to go merrily on for as long a time as it did, and to accomplish so much, there must have been an abundant supply of water, more by far than at the present time.

The need for a plentiful water supply at once carries one in thought back to a time immediately preceding the present, the closing days of the Glacial period in this region. At this time of moderating temperature, when the perennial snows of countless winters were melting away from the higher lands, accessible parts of the earth's exterior must have been quite saturated with water. Actively moving waters pick up and carry away the materials with which they come in contact. Quiet or sluggish waters are quite as likely to deposit parts of their burden in favorable positions as they are to take them away from others.

And so there came a time, as glacial conditions slowly disappeared, when the quantity of water finding its way into this body of marble was no longer sufficient to accomplish any great amount of erosive work. The dwindling and even actual drying up of underground streams left the great openings which they had been instrumental in forming; their former courses, the deep cañons, the gulches, the dark channels which they made and occupied, became the halls, corridors, and tunnels of the caves we frequent today.

When underground passages become too large their roofs collapse for want of support and the walls tumble in, just as we see they have done in the more spacious rooms in all known limestone caves throughout the world. In limestone regions the land surface itself is pitted by an undermining of the rock beneath, and sinks, natural bridges, etched pinnacles, and balanced rocks result.

Fortunate indeed it is for us who now look on, that the processes of destruction in the case of the Oregon Caves did not proceed so far as to injure irreparably the structure of the rock formation which long harbored them. Innumerable openings were formed, it is true, but so far as we have yet been privileged to observe, very few were so large that their walls and roof have failed to support them. It is this fact largely that has provided the opportunity which we enjoy today of studying one of the most intricate, assiduously perfect pieces of natural handiwork to be found anywhere. And although its production was the task of ages, as human generations are counted off, the transcendent perfection with which it was carried out could have been accomplished only in the profound quietude of the dungeon, far from the light of day, where the changes of the seasons were of no avail, and where the storms of winter and the balm of outside summer were ineffective and unknown.

Nature appears to object to cracks and crevices; to her they are blemishes, imperfections in the earth structure which should be repaired. And she sets zealously about the task of healing such breaks. Openings in rocks anywhere are elements of weakness, and nature's

A detail of the decorative finish in "Neptune's Grotto."—Multiform shapes and designs have been fashioned by the lime-laden waters—mostly fantastic but occasionally realistic. Note in the lower foreground the female figure known as "Neptune's Daughter." Often the deposits are in the form of broad sheets, like draperies of waving outline, as though possibly currents of air may have coursed through the darkness of the galleries in the past. In fact, even today in certain of the chambers drafts of air are strong enough at times to extinguish an unprotected light plan is one by which she proceeds to fill the gaps and thus strengthen the structure. She fills them with the materials nearest at hand. In this case, the materials of repair are the same as those of which the rock—marble—is itself composed. Chemically it is lime carbonate; as a mineral it is calcite when pure and crystallized.

The "cauliflowers" in the "Petrified Gardens" required thousands of years "to bloom." The water flowing, dripping over the irregularities of the wall, slowly deposited the coating of lime carbonate, particle by particle, layer upon layer. The caves are officially open to the public from May 15 to September 15 each year

Water is the agent by which the healing process is carried on. It dissolves in places of plenty and transports to points of weakness, where it skillfully applies layer after layer, as a soothing lotion to an open sore. The jagged surfaces of rough rock walls are coated over, furrowed ceilings are smoothed out, floors harmoniously carpeted to match. In some places pillars rise from the floor or drop from the roof as though temporarily to steady a precarious span. And it seems to be a characteristic of the manner in which this agent of restoration works, that there will be found at almost any stage the most exquisite surface finish. Ceilings and walls are frescoed with well-nigh unwarranted elegance, alcoves, balconies, and corridors are fringed with the most immaculate of draperies, floors silk-lustered and never meant for the tread of feet. Ever dissatisfied, it would seem, with the results obtained, a fresh coat is put on, and then another, each differing from the one it covers up—not in substance, but varied in design infinitely or infinitesimally, as the case may be.

Small openings are thus soon filled, and the former walls are finally and securely tied together by a reticulated network of crystalline mineral which may vary from a mere filament in width to veins several feet across. These are the scars that result from the healing of the wound, and it is through them only that, oftentimes, we are able to decipher the course of past events. In the Oregon Caves, however, few of the openings have yet been closed. We have, as it were, caught nature in the act, when the process of healing is but just well started. In most of the rooms in the caves, only the "sizing," to use a builder's term, has been applied as a background for later finish. We can observe that the work is still going on in many rooms, although obviously not so actively as it has in the past. In others the finishing touches appear for the present to be completed and activities temporarily suspended.

From our standpoint, therefore, it is a stroke of extreme good fortune that the filling of these caverns has reached no more advanced stage than it has. Had it not yet begun, we should today gaze upon lusterless rock walls, etched and roughened and angular, and peer into somber depths that would return scarce a single responsive flash to our swaying candle flame. As it is, with the process just well under way, marvels are revealed at every turn. Not a room or passageway but has received the painstaking attention of the master hand. The formations are curious, and many bear fancied or actual resemblance to interesting objects of various

A detail of crystalline deposit in the "Queen's Reception Room." —It is no vagary of the mind that the graceful figure of her majesty is to be seen confidently poised beneath the encircling archway of this massive, rock bound throne

THE CARELESS DESTROYER OF NATURAL BEAUTY HAS BEEN EVEN HERE

The "Cathedral Chimes" in "Judicial Hall" (upper photograph) have the appearance of a musical instrument. They are pendent stalactites which produce musical tones when cautiously struck with a stick or piece of metal. Obviously due caution has not always been observed by the players of these chimes. The lower photograph, taken in "Joaquin Miller's Chapel," presents a view of the "Washington Monument" of the caves which rises far above the heads of tall men kinds: they are weird, fantastic, awesome. Always and everywhere there is the glimmer of crystal facets in response to the searching movements of our lights; in places the walls glow softly as the sheen of velvet, elsewhere they are lighted and ablaze with myriads of dimly reflecting mirrors, the twinkle of distant stars: and then again, and over and over, are thrown back the scintillating fire and flash and color play of the true-cut diamond.

Systematic exploration of the numerous intricate ramifications of the caves has not yet been made. Doubtless many openings not now known will be discovered, and passageways made so they may be reached in a tour of the caves. Starting in at the lower or main entrance, the visitor now travels about three and one half miles underground, reaching daylight again in three hours, from the same opening.

Picturesque, fantastic, sometimes significant names have become attached to objects within the caves. On entering, one soon crosses the "River Styx," and moves cautiously past "Old Satan's Caldron." Later "Cathedral Chimes" and their harmonious tones prepare him for a passing view into "Bottomless Pit," whence with due solemnity of manner he passes "Adam's Tomb," and gazes into "Jacob's Well" near where, in prayerful posture, is the "Kneeling Camel." In "Old Nick's Bedroom" we see yet another of his Satanic Majesty's exquisite apartments, and then by way of the "Coral Gardens" we approach "Queen Josephine's" place of abode. Farther on we are treated to a safely distant glimpse of the "Bacon Room" and through the "Wiggle Hole" come to "Elijah's Statue" (named in honor of the discoverer of the caves). Beyond "Fat Man's Grief" we skirt the "Graveyard," and, rather out of the customary order of events, are then ushered into "Joaquin Miller's Chapel." The "Ghost Room" is fifty feet wide by forty feet high, perhaps a few hundred feet in length, and, it is said, is the largest room yet opened up.

Another view in "Joaquin Miller's Chapel," which, again, tells nothing of the magnitude of the cavern formations, their color, their reflective surfaces—just as it conveys no sense of the unending solitude—and the silence except for the drip, drip of water—in which these caves lie and have lain during the age-long process of their formation. That the formation is still in progress in various parts is of high value to our understanding of how it has all come about

To describe the Oregon Caves adequately is not possible. Photographs record in their mute way the outlines of things, but give no vivid expression of life in the objects they depict. Nor do they convey in the slightest degree a sense of the unending solitude in which these cave objects grew and now exist.—a sensation the thrill of which can come only to him who frequents these underground ways, and who thoughtfully reflects upon their meaning and the lessons that they teach.

The Water Supply of a Great City[1]

A RECORD OF THE CONSTRUCTION OF THE CATSKILL SYSTEM FOR NEW YORK

By CHARLES P. BERKEY

Professor of Geology, Columbia University; Consulting Geologist, New York City Board of Water Supply

THE water supply of every large city is a serious problem. Local sources which may have been entirely adequate in the beginning are outgrown or have become hopelessly contaminated, and, ultimately, more or less distant back-country sources must be developed.

These additional supplies are usually mountain- or hill-country surface streams with large enough drainage area to furnish sufficient volume and of good natural purity if possible. If there is any question on that point, steps are taken either to guard the supply from contamination or to filter the water or otherwise treat it to accomplish the desired result. More rarely, artesian well supplies may be relied on, but the natural conditions that make them possible do not everywhere exist.

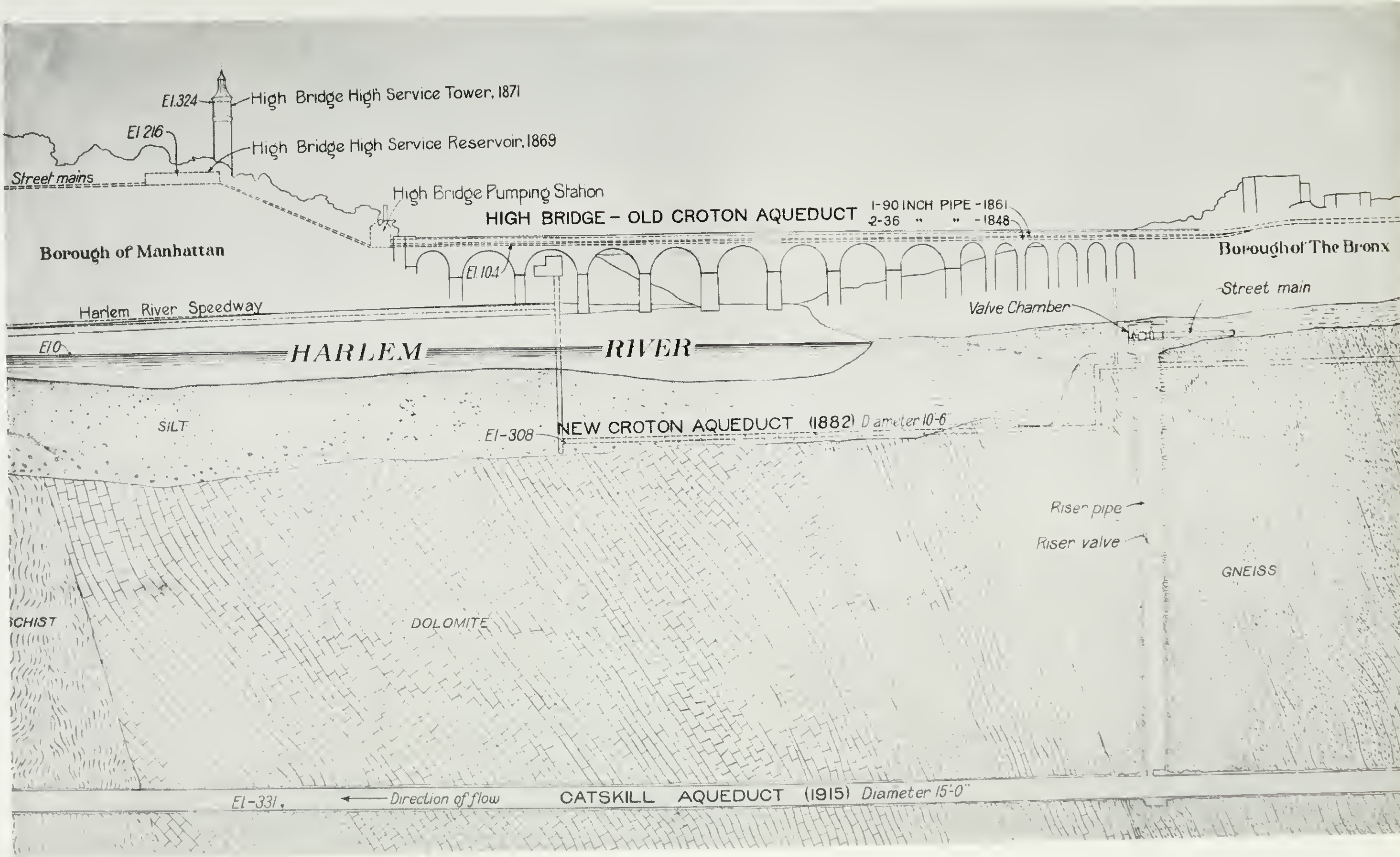
Rapidly growing cities such as New York present an ever changing problem. The population of New York increases something like a hundred and twenty-five thousand a year,—about as many people as live in Albany or Bridgeport or New Haven. Every five years its increase amounts almost to a Boston or a Cleveland or a Baltimore. In the early days such phenomenal growth could not have been foreseen, or provided for even if it had been foreseen.

In 1820 New York had a population of probably not more than 110,000. Now, a hundred years later, it has more than 5½ millions, roughly, fifty times as many people. In that time the water supply has been outgrown many times. At first well waters and surface waters within the city limits were used. Even distant supplies for those days are now within the enlarged city limits and New York has long ago abandoned nearly all of them in favor of still more distant supplies from Long Island, the Highlands, and the Catskill Mountains.

Brooklyn has always had a complex supply, both in quality and source. Separate companies developed local supplies and served limited sections of the city. Some of the supplies came from surface streams, some from artesian wells or deep wells, and still others from shallow wells. Most of these have gradually been reorganized into more of a unified system, but at its best, Brooklyn has had an inadequate supply and long ago began agitation for development of new water resources. The city had at one time large plans for the development of the Long Island sources, but legislative obstruction prevented their execution. There has been a good deal of expansion, however, and a total of something more than 150 million gallons of water a day is furnished from the wells and streams of the south side of Long Island.

In 1848 the first Croton Aqueduct was completed, bringing water from the Croton River, a distance of thirty-four miles, crossing the Harlem River on High Bridge, one of the engineering landmarks of the city, to the reservoirs in Central Park. This original aqueduct was capable of delivering 80 million gallons a day. In 1890 the New Croton Aqueduct, thirty-one miles long, was finished. It is capable of carrying 300 million gallons a day. It enters Manhattan by a tunnel in rock beneath the Harlem River a short distance north of High Bridge.

[1] With official photographs, many of which have not been reproduced heretofore, taken during the construction work, and used by courtesy of the Board of Water Supply, New York City.



THREE AQUEDUCTS INTO NEW YORK CITY

Diagrammatic comparison of the "Old Croton," the "New Croton," and the Catskill aqueducts, with geologic cross section of the rock structure in the vicinity of High Bridge near which all of these conduits cross the Harlem River into Manhattan. The Catskill Aqueduct tunnel was put through solid rock 331 feet below the surface of the Harlem River (below sea level), the New Croton at 308 feet, and the Old Croton is carried over the river on High Bridge

A CUT-AND-COVER TRENCH TYPE OF AQUEDUCT

The Catskill Aqueduct under construction through country whose elevation made the cut-and-cover type of structure possible.—It is essentially a great trench, with a concrete floor and arched roof, graded so that water will flow of its own accord slowly toward New York City. The finished conduit is 17 feet high by 17½ feet wide, inside measure, with walls nowhere less than 12 inches of solid concrete

THE CONCRETE CONDUIT SEVENTEEN FEET INSIDE MEASUREMENT

An almost completed stretch of cut-and-cover aqueduct.—The concrete conduit has been finished but is still to be covered with earth for protection. This is one of the deeper cuts in rock made for this type of construction. The spot shown is along the west side of the Wallkill Valley near Lake Mohonk. About one half, or more than fifty miles, of the Catskill system is of this cut-and-cover type. The water is delivered from the great storage reservoir at Ashokan to an equalizing reservoir just north of New York City from which it enters the eighteen-mile distribution tunnel. An additional emergency reservoir north of White Plains is also supplied and retains thirty days' emergency supply

A BORING RIG FOR THE CATSKILL AQUEDUCT

A boring rig exploring the underground conditions on Delancey Street near Allen before construction was begun. The boxes piled on the sidewalk contain drill cores taken from the rock beneath. Interpretation of these borings is depended upon to determine the conditions that will have to be met when the tunnels are constructed. The finished aqueduct passes beneath this point now at a depth of more than 700 feet below the street level

Heavy drain on this system made it necessary to build a much larger dam known as the new Croton dam, and many smaller ones for storage reservoirs in the Croton watershed. There is, however, a limit to the amount of water that can be recovered economically from a given area. To save all of the overflow in the rainy season may cost more than to secure a much larger amount by developing a new source. The capacity of the Croton watershed, it could be seen, was being approached; and even before the later developments for additional storage were completed, the city authorities were looking about for an entirely new supply. Preliminary investigations for comparison of the advantages of different possible sources were carried out by a commission of engineers. As a result of these studies the legislature authorized development of new sources, and in 1905 the newest and most extensive of all the water projects of this or any other city was organized.

This is known as the Catskill Water Supply project. Surface waters in the heart of the Catskill Mountains are impounded and brought more than a hundred miles to New York City. The building of the great Olive Bridge dam at Ashokan on the Esopus, where the main storage reservoir with its 130 billion gallons of water is located, the construction of more than fifty miles of tunnels and an equal amount of cut-and-cover aqueduct, with an additional storage reservoir north of White Plains, holding thirty days' emergency supply, and the making of an equalizing reservoir just north of the New York City limits and an eighteen-mile distribution tunnel from that point down through the length of the city, with which the mains of the city are now connected, constituted an engineering project of mammoth proportions and difficulty. Skill of the highest order has been required in its construction, and ingenuity has been taxed to the limit in solving some of the problems.

Nearly two years were taken in exploration, planning, locating, and relocating prospective dams and tunnels and other works; but by midsummer, 1907, actual construction began. The first sod was turned by Mayor George B. McClellan, June 30, in the vicinity of Garrison in the Highlands. Since that time construction has been continuous and the major portion of the

Seven hundred feet below the boring rig.—How some of the rock looked in the tunnel beneath Delancey Street. The rock is Inwood limestone, showing complicated folding, crumpling, and faulting, and is cut through by a granite dike. This photograph was taken more than 700 feet beneath the surface of the street

AN UNDERGROUND WATERFALL

A wet stretch of ground in the tunnel near Jerome Park reservoir in the Bronx.—Water in large volume poured out of a big joint in the rock. Of course there was no chance for a waterfall until the tunnel was driven through. Such occurrences are not common. They give much trouble both in driving the tunnel and in final concreting. This is the underground water which almost everywhere fills the crevices in soil and bed rock after getting a short distance below the surface and is the supply for wells and springs. The flow is frequently very strong, and in the tunnel under Rondout Valley more than 1900 gallons of water a minute poured in through similar leaks. The water enters along joints or stratification planes or directly from the surface by way of fault planes

CRUMPLED ROCK IN THE CITY TUNNEL

The most crumpled rock encountered beneath New York City in the eighteen-mile tunnel that completes this end of the Catskill Aqueduct.—The rock is Manhattan schist, the same general type that one may see in Central Park, but this is a rare exhibit of its most complicated structural habit. All of the schist of Manhattan is characterized by remarkable crumpling folds, varying from small plications of a few inches to great arches such as form the major ridges of the island, and indicating a former deformation of the rock of considerable magnitude. Much trouble may be experienced in tunnels through folded rocks, if they show marked fracturing, and the engineers had to give careful attention in such situations to geological structure

CONSTRUCTING THE AQUEDUCT TUNNEL

More than fifty miles of such tunnels were driven through solid rock for the Catskill Aqueduct. This photograph shows the electric feed wires, ventilation pipes, water and air pipes, haulage tracks, and engineer's transit platform as they looked during the construction of the rock-tunnel type of aqueduct. In order to carry the water across valleys, tunnels were dug under them. These acted as inverted siphons which at times dropped below sea level. The water was also finally delivered in the city by pressure tunnels which were placed from 250 to 700 feet below the surface in order to insure against the danger of disturbing other structures. These miles of tunnel have revealed a great variety of geological information on hitherto very imperfectly known features of the structure of New York project was sufficiently completed late in 1915 to permit the delivery of water directly to the city mains.

But the finishing of its various parts and connections and extensions has continued to the present time. The last section to be added is the Schoharie supply on the north side of the Catskill divide. A great masonry dam is being built at Gilboa on Schoharie Creek that will impound the water from two hundred and fifty square miles of territory. This water is to be diverted by an eighteen-mile tunnel back through the Catskills beneath the highest mountain peaks of the range and added to the waters of the Esopus, finally reaching Ashokan reservoir, where the whole supply gathers.

To complete this last unit will take three or four years more. Altogether perhaps the whole project will have covered twenty years. When it is finished the city will be furnished perpetually with something like 500 million gallons of water a day from the heart of the Catskill Mountains, water that is so pure that neither filtering nor other treatment is necessary.

The bare figures themselves are interesting to anyone who appreciates their magnitude and significance, but, in addition, many special problems have been encountered that have an appeal of their own. The nature of some of these problems can be appreciated most readily by a little more specific explanation of the nature of the general design, the objects to be attained, and difficulties to be overcome. For example, it became necessary to construct a dam that would hold back 130 billion gallons of water without serious loss or danger of collapse. If the water leaks out the whole project is a failure or if the dam gives way the valley below will be devastated. A place must be found and a design adopted that will accomplish both ends. Thus its location or the choice of dam site is of prime importance. More than a year of exploration preceded its selection. Esopus Creek, flowing as it does in certain stretches in a narrow rock gorge, looked simple enough, but its present-day course is quite different from its ancient pre-Glacial one. Exploration showed an old channel at one side more than a hundred feet deeper than the new one, completely buried beneath the glacial drift. In most places this drift filling of the ancient gorge was itself porous and it would be leaky ground on which to locate a dam. Finally, however, at Olive Bridge it was found that the quality was dense and tight and capable of holding water. Here the dam, more than two hundred feet high, has been constructed successfully. Behind it is held in storage enough water to cover Manhattan Island to a depth of twenty-eight feet.

The water in Ashokan reservoir stands at about 590 feet above tide whereas New York City lies almost at sea level. On account of this difference of elevation it should be theoretically possible to construct an aqueduct between the Catskills and the city that would allow the water to flow by gravity in trenches or pipes and deliver itself. This looks simple enough but a little consideration of the problem shows that the Catskill supply lies on the west side of the Hudson Valley, whereas New York City lies on the east side, and to reach the city it would be necessary to cross several large tributary valleys besides the Hudson gorge itself. In addition two considerable mountain tracts, the Shawangunk range and the Highlands, have to be crossed. It is apparent, therefore, that it would not be possible to build a simple grade aqueduct but that some plan would have to be devised for crossing the valleys that are too low and penetrating the mountains that are too high without losing the head of the water. Otherwise it must all be pumped at these discordant points, thus adding to the expense of delivery.

FINISHING THE PRESSURE TUNNEL AQUEDUCT

A stage in the finishing of the rock-tunnel type of aqueduct. The concrete floor ("invert") has already been laid. On it rests a removable steel framework supporting steel plates to give form to the finished structure. Cars loaded with concrete mixture are then run in on a platform and the concrete is poured over the sides, ultimately filling the entire space between the jagged rock walls and the steel frame. After the cement sets, the frame is removed and set up a little farther on and the process repeated

AN AQUEDUCT TO CARRY 500 MILLION GALLONS A DAY

The finished pressure tunnels look like this. A smooth concrete conduit carries the water. Irregularities of the rock walls of the original tunnel are all filled. Note that the imprint of the steel plates of the form, against which the concrete mixture was poured and allowed to set, can be plainly seen on the inner surface. This section is 16 feet in diameter in the clear. It is probably as nearly permanent and indestructible and safe from interference and contamination as it is possible to construct

The Spillway.—Arrangements are always made with great care for the overflow of surplus or flood waters. At certain seasons the withdrawal of water for use cannot keep pace with the supply, and unless suitable provision is made for the overflow to escape under controlled and safe conditions, it is likely to endanger the stability of other structures. This spillway is more than two miles distant from the main dam and is constructed of solid concrete and bluestone slabs. The water is carried away in a channel floored with bluestone, set on the rock ledge, escaping finally to Esopus Creek

There are several possible methods of accomplishing this result. For example, one may carry the water across on a bridge, just as the old Croton Aqueduct crosses the Harlem River on High Bridge. On account, however, of the size of the conduit required and the width and depth of some of the valleys to be crossed, this plan was not considered feasible. In the case of smaller supplies and where the valley depressions are not so deep, iron pipes are sometimes used, but no experience is available for work of such magnitude as this. It was finally decided to accomplish the same result by the construction of tunnels in bed rock beneath the valleys. Water entering on one side of a valley thus passes beneath the valley and up again to grade on the near side by its own pressure.

Wherever the country-side lies at about hydraulic grade (the level of simple surface flow) the cut-and-cover type of construction is used. This is essentially a trench, made as if the water were to flow in it as in a ditch: but the trench is concreted and enclosed so as to make a closed conduit. Intervening mountain ridges are penetrated by tunnels at grade.

The whole aqueduct, therefore, is made up chiefly of a combination of these types of construction,—the cut-and-cover aqueduct, the grade tunnel where hill or mountain rises across the course, and pressure tunnel beneath valleys and gorges. By this method the Catskill water actually delivers itself to Hill View reservoir on the north line of the city at an elevation of 295 feet above sea level. In its course it flows along valley sides and through mountain ranges at grade and beneath valleys and gorges under pressure, but its movement is steady and sure toward its destination, moved by forces costing nothing for endless service.

Catskill water leaving the reservoir passes through the aëration plant and then flows for several miles in a cut-and-cover aqueduct at grade at about five hundred feet above tide. The first large problem is presented by the necessity of crossing the deep and broad Rondout valley. A tunnel beneath the valley was finally constructed, four and one-half miles long, which, to avoid bad conditions, such as buried stream gorges, underground caves, and abnormally hard rock, was placed three hundred and fifty feet below sea level. It penetrates twelve different geological formations and cuts through some of the most difficult ground encountered in the whole line. At one spot so much water poured into the tunnel that it required a pumping capacity of more than one thousand nine hundred gallons a minute to keep the tunnel clear enough for construction to proceed.

The most spectacular of these pressure tunnels is the one beneath the Hudson River. Choice of place for crossing the Hudson was a question to which much attention was given. From Storm King Mountain to Breakneck at the northern entrance to the Highlands was finally selected as the best spot because of the quality of rock at that point. When explorations were made, however, it was found practically impossible to determine by ordinary methods the depth of the gorge and consequently how deep the tunnel would have to be placed. The Hudson gorge is an ancient one that was cañon-like in its form in pre-Glacial time and has since been partly filled with glacial drift and silt. Because, also, of the depression of the continent, the river has been drowned so that sea water backs up into the Hudson valley. Borings in the middle of the river finally penetrated river silt and bowlders to a depth of 765 feet without finding the bottom of the gorge. Inclined diamond drill holes from the sides of the river, however, indicated that solid granite rock existed entirely across beneath the river at 950 feet. An additional set of borings showed that the same rock existed at 1100 feet. It was decided on this information to construct the tunnel beneath the Hudson at 1100 feet below the surface of the river. This is the deepest section on the whole Catskill Aqueduct.

The intervening country is so varied in its geological features that each succeeding section of the line has problems of its own. The aqueduct crosses the Highlands north of Peekskill, passes beneath Croton Lake reservoir, and touches Kensico reservoir north of White Plains, where thirty days' supply is held in storage.

From Hill View reservoir on the north margin of the city the water enters the so-called City Tunnel, a pressure tunnel in bed rock eighteen miles long, ending at Fort Green Park in Brooklyn. Twenty-four working shafts were used during its construction, twenty-two of which are still used to connect with the distribution conduits of the city. Because of the danger of disturbing other structures, and as a measure of safety, the tunnel is placed from two hundred and fifty to seven hundred feet below the surface, the deepest portion being on the lower side between the Bowery and the East River and across the East River to Brooklyn. In its course it penetrates a great variety of geological conditions and has exposed features that were only imperfectly known before.

The maximum supply of water is not yet available but from 250 to 300 million gallons of water a day can be furnished. As soon as the Schoharie addition is completed on the north side of the Catskills, this water added to that of the Esopus will furnish at least 500 million gallons a day. This amount doubles the water supply of the city and seems to provide for requirements for many years to come.

PANORAMA OF ASHOKAN RESERVOIR

The reservoir as a whole covers nearly thirteen square miles of surface. The photograph shows both the upper (left) and the lower (right) basins with the dividing weir. Olive Bridge dam stands at the extreme right of the upper basin. The gate chambers, aëration plant, and beginning of the aqueduct stand in the angle between the two basins at the right

THE AËRATION PLANT AT ASHOKAN

At this point the Catskill water begins its journey. The water in the reservoir stands about seventy-five feet above this battery of 1600 nozzles, and when the gates are opened, it is forced by its own pressure high into the air, where it breaks into spray and, thus mixed with air, falls back into the basin and enters the aqueduct. This is essentially a purification process. Agitation of water so as to mix with air, as in a brook, is well known to eliminate impurities with remarkable success. The aëration plant does this same thing on an immense scale

Our American Game Birds

Especially in review of "The Game Birds of California,"[1] a volume issued from the University of California Press

By FRANK M. CHAPMAN

Curator of Ornithology, American Museum of Natural History

GAME birds constitute one of our most important assets in bird life. Time was, and that not very long ago, when their value was estimated in what they would sell for as food. But necessity has broadened our vision. There has been increase in population and corresponding decrease in the area available for birds, several million sportsmen are taking the field each year, automobiles and power-boats make every corner of the country accessible, and a dozen other destructive factors are at work. It became apparent, therefore, some time ago to even the most short-sighted and selfish hunter that the game birds of the country would soon be a memory unless radical measures were taken to diminish the number legally killed each year.

Even assuming that the laws were observed, they were far from strict enough and were often made in the interest of the hunter rather than for the protection of the hunted. Sportsmen who looked to the future of sport, and ornithologists who studied the situation from a broad, scientific viewpoint, saw that there were two measures of the greatest importance to insure the continued existence of our game birds. These were, first, prohibition of their sale and, second, uniform protective laws based upon scientific principles wherein each species was considered not from a local but from a national or even international standpoint.

Under certain conditions game birds constitute a natural and proper source of food; but when the demand so far exceeds the supply that the latter is threatened with early extinction, it is obviously time to stop and take account of stock. In short, we were confronted by the old question of the goose and the golden egg. Fortunately we have decided to be content with the egg. In other words, despite the protests of game dealers, hotel and restaurant keepers, epicures and gourmands, we now consider our remaining game birds to be of more value to sportsmen than to market hunters. This decision is based on sound ethics and equally sound economics. The sums the sportsman is willing cheerfully to expend for guides, dogs, boats, transportation, board, and in the maintenance of private preserves, become, in the aggregate, an amount in comparison with which the actual food value of the game pursued is insignificant. And this is wholly aside from the pleasure and benefit derived by the sportsman in the pursuit of game. It is obviously good business, therefore, to protect a capital which pays so high a rate of interest. The sale of wild game is consequently almost universally prohibited throughout the country and game birds are thereby conserved primarily for sport instead of for food.

The elimination of the pothunter, however, by no means solved the problem of game protection. The "gamehog" still remained. But the replacement of state by federal regulations, through the passage of a treaty with Canada covering migratory birds, is a guarantee that the preservation of the birds rather than the wishes of the sportsman will be given first considera-

[1] *The Game Birds of California.* By Joseph Grinnell, Harold Child Bryant, and Tracy Irwin Storer. Contribution from the University of California; Museum of Vertebrate Zoölogy. University of California Press, Berkeley, 1918. Royal 8vo, 642 pages, 16 colored plates, 94 figs.

THE MOUNTAIN AND CALIFORNIA QUAILS

From the painting by Louis Agassiz Fuertes

The former (at the left) indentified by its large size and exquisite coloring, is the most beautiful quail known; its small numbers and the mountainous habitat limit its use as a game bird. It is conceded that the California quail, together with its subspecies, the valley quail (*Lophortyx californica vallicola*) is California's finest game bird. California and valley quails have been introduced successfully into other western states but do not thrive in the East—any more than our bobwhite thrives when transplanted to California. Fortunately, it is illegal to sell quail of any species in California except for propagation and then only under permit. What is needed for the beautiful mountain quail of California—and for our eastern bobwhite in many localities—is a complete close season for several years until the species recuperate

tion; moreover, the limits placed on the number of birds which may legally be killed in a day acts as a further curb on the thoughtless or selfish hunter.

The backbone of this movement, which has occupied the attention of conservationists for years, is public sentiment based on a knowledge of the innumerable facts involved. It was only when the public was sufficiently impressed with the urgent need for stricter game laws, if our game birds were to be saved from extinction, that the passage *and enforcement* of such laws became possible.

This campaign of education has been conducted by the Audubon Societies, Game Protective Associations, Federal and State governments, and other educational agencies, largely through the issuance of informative publications. One of the most noteworthy volumes among such publications which have thus far appeared is *The Game Birds of California*. Convinced by extended field work that the game birds and mammals of the state were rapidly decreasing, the staff of the Museum of Vertebrate Zoölogy, of the University of California, decided that in order to make the game laws effective "the people at large must be apprised of the facts and shown the need for, as well as most effective means of, conserving our game resources." Thanks to friends of the Museum interested in the protection of wild life, funds were provided which made possible the production of this admirable volume.

Introductory chapters treat of the "Decrease of Game and its Causes," "The Natural Enemies of Game Birds," "The Propagation of Game Birds," and kindred subjects. The greater part of the volume, however, is devoted to detailed biographies of the game birds themselves; that is, of California waterfowl and shore birds (snipes, plovers, etc.), quail and grouse, pigeons and doves. The roseate spoonbill, wood ibis, and white-faced glossy ibis also are included, although these birds are not commonly ranked as game.

Full biographies record what is known of the life history of each species and a wealth of data concerning its present and past status in California is given. With those birds which have been most hunted the story is invariably one of wholesale slaughter and rapid decrease.

It is estimated, for example, that 250,000 ducks were sold in San Francisco markets in the season of 1911–12, but in 1915–16 the number had fallen to 75,000. In 1909–10 one transfer company in San Francisco sold more than 20,000 geese, and the rate of destruction indicated by these figures was continued until the birds became comparatively rare. It is not alone statistics of this kind in which the volume abounds but also authoritative accounts of the habits of the birds monographed which should arouse a keen interest in them and hence in their continued existence.

The book makes a further appeal through its well-produced colored illustrations by Louis Agassiz Fuertes and Allan Brooks, as well as by an attractive format.

The authors are scientists, not sportsmen, and they handle their subject from the standpoint of ornithologists rather than from that of the hunter. The book, therefore, is lacking in descriptions of methods of killing birds and stories of the hunt, and the end its authors have in view will probably be better served by the omission of matter of this kind. But, in the reviewer's opinion, its message would have been stronger if it had dwelt with greater emphasis on the value of game birds as a bond between those who pursue them and the marshes, fields, and forests in which they live.

Caiman Hunting in South America

By ALBERT M. REESE
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IT was the writer's privilege to spend a recent summer at the Tropical Research Station of the New York Zoölogical Society in British Guiana, the main object of the expedition being to collect embryological material of the caiman for researches under the auspices of the Carnegie Institution.

While the caimans, according to Beebe,[1] are the only crocodilians represented in British Guiana, at least four species of the genus are found there, the largest of which is the huge, supposedly man-eating black caiman, *Caiman niger,* confined apparently to the upper reaches of the rivers at some distance from the coast. In the region of the station, about fifty miles inland, caimans are very scarce; the only one seen during the summer was a small one killed by the Indian hunters employed by the station.

Along the coast, especially in the region of the Abary River, in the eastern part of the colony, the smaller species of caiman, rarely reaching a length of seven feet, are so abundant that they may frequently be seen from the car windows of the trains of the Demerara Railroad as these pass over the swamps and rivers.

Crocodilians are hunted for various reasons. In Florida the alligator is, or was, hunted chiefly for sport, and for its hide when alligator leather was in vogue. The caiman, since its hide is too heavy and osseous to be useful as leather, is hunted mainly for the sake of its eggs. This source of danger to the caiman, however, is but slight, as the haunts of this species are off the line, somewhat, of the sportsman-tourist routes. The eggs are collected by the natives for two reasons: first, for the purpose of hatching them under artificial conditions to obtain young animals for stuffing as souvenirs; second, merely to reduce the number of caimans—or "alligators," as they are commonly called—which the planters consider a pest on the sugar and rice estates, although the economic status is probably not at all certain. It was the eggs that the writer was particularly anxious to obtain, although he was also much interested in the general habits of the animals.

As in the case of the writer's previous experiences in the search for alligator eggs in Florida, the first thing to do was to find a native hunter to act as guide and bureau of information, although the information obtained from such people is usually anything but reliable. In Florida, years ago, the best known 'gator hunter was probably Alligator Joe, of Palm Beach. The "Alligator Joe" of Georgetown is a tall gentleman of Ethiopian extraction known as "Professor Pile," who is considered the local authority on all matters relating to "alligators." A meeting was promptly arranged with the "professor," who agreed, at the end of a week's engagement which he then had, to locate all the nests needed to obtain the desired embryological material. He was evidently anxious to collect the eggs himself, rather than to act as guide to locate the nests, and the dangers and trials of hunting 'gator nests were depicted in as terrifying terms as possible. Having had much more extensive experience with the *Crocodilia* than the professor realized, the writer insisted that he was looking for a guide rather than a collector, and arrangements were made for a two-days' trip to a famous collecting ground within easy reach of Georgetown. As a last, but by no means least, preliminary the guide was asked his charges. "Forty dollars a day and expenses," was the modest reply. Diplomatic relations were severed

[1] *Zoologica*, Vol. II, Nos. 7, 8, 9, p. 211, 1919.

on the spot and another guide, perhaps less famous, was secured at three dollars a day. With this man, and later, with a gentle-mannered young East Indian named Perong (nearly all of the labor of this British colony is performed by men and women imported from India), the canals and ponds in the region of Georgetown were explored in a search for the not very numerous caiman nests.

After I had learned the general lay of the land, the services of the guides were often dispensed with; but when it was necessary to wade across some muddy canal or pond, through flags and other water plants, sometimes neck-deep, with a "cutlass" (the universal implement of the coolies, corresponding to the "bolo" of the Philippines and the "machete" of Cuba) as the only weapon in case of attack by some caiman mother, the absence of the guide was not always to be desired. Professor Pile's harrowing stories to the contrary, however, no indication of aggressiveness by the animals whose nests were being robbed was ever seen, in which the caimans resembled their mild cousins of Florida, the Mississippi alligators.

Some of the pleasantest expeditions were those taken with Perong, who lived in the village of Peters Hall and worked on one of the huge sugar estates which are the chief industry of the colony. In his slender dugout in one or another of the large irrigation canals that parallel each other at short intervals across the sugar estates, we paddled or poled, according to the depth of the water, going about on these grassy waterways with considerably more comfort than was possible in walking beneath the tropical sun that at midday cast a very short shadow toward the south. Perong's English vocabulary was rather slight, but we managed to understand each other and his knowledge of the language of the coolies enabled us to make inquiries about the location of nests.

One of the first nests located by Perong was a small one so low and flat that it looked like an abandoned nest of some past year. On digging into it with a cutlass, we found it contained twenty-three eggs with well-advanced living embryos in them. As in

The Tropical Research Station of the New York Zoölogical Society, Katabo Point, British Guiana (seen from the Mazaruni River)

Perong, the East Indian guide, with his dugout, in one of the sugar estate irrigation canals.

Caiman's nest (lower picture) beside an irrigation canal and exposed to the full force of the sun


Mr. Gordon and three coolies, with trophies of the caiman hunt

the case of the alligator, the nests of the caiman differ widely in size and appearance. The one shown among the illustrations was, like those of the alligator, built of the flags and grasses growing in that vicinity and was in the open, exposed to the full fury of the tropical sun. Many caiman nests, however, are built of a mass of fine vegetation and dirt, scraped up from the ground. Such a nest we found located beneath a thick mass of bushes, where the direct rays of the sun could seldom, if ever, reach it. A similar shaded location for a nest was on the shore of one of the ponds in the Botanical Gardens of Georgetown. In these ponds caimans are found, and they build their nests in the bamboo thickets. When lying quietly in the water among the victoria regias, the caiman's protective coloration is so perfect that only a keen eye can locate the animal, which usually sinks quietly beneath the brown water before a shot at it is possible.

Such bamboo thickets serve as nesting places for countless birds—herons and the like—and it is probable that the young birds furnish an abundant supply of food to the caimans that lurk in the waters beneath.

Not having secured all the material desired in the vicinity of Georgetown, I decided to visit the eastern part of the colony, in the region of the Berbice and Abary rivers, where, it was said, "alligators" were much more numerous. On writing for information at the suggestion of a mutual acquaintance to Mr. J. R. C. Gordon, the manager of the well-known Blairmont Sugar Estate, I received a very cordial invitation from this courteous English gentleman to be his guest and use his house as a starting point in the search for caiman nests.

Hunting alligators with Mr. Gordon, who decided to take a short holiday and go along, proved to be hunting *de luxe*. Instead of a dugout and paddles for two, we two Anglo-Saxons had a boat with a comfortable seat, one coolie to steer and three others to serve as motive power by dragging the boat by means of a long rope from the towpath of the canal. In this luxurious manner we followed the canal for ten miles or more to our destination on the Abary River. Along this canal were seen various birds, among them numerous hoatzins or Canje pheasants, those curious birds with persistent reptilian characteristics, so interestingly described by Beebe.[1] On reaching the end of this stage of our journey we found another boat that had preceded

[1] *Zoologica*, Scientific Contributions of the New York Zoölogical Society, "A Contribution to the Ecology of the Adult Hoatzin." Vol. I, No. 2, pp. 45–66, Dec., 1909. Also *Tropical Wild Life in British Guiana*. By Beebe, Hartley, and Howes. Vol. I, pp. 155–82, 1917. Also NATURAL HISTORY, "The Hoatzin—Only Survivor of an Ancient Order of Four-footed Birds." By Edward M. Brigham. February, 1919, pp. 163–69.

us, with provisions, mosquito nets, and numerous coolies to administer to our needs. Altogether there were thirteen East Indian coolies to take care of two perfectly healthy Anglo-Saxons.

At the Abary River we embarked for a short journey down that narrow but deep stream. Our vessel was the "Creation." On the great sugar estates the cane, which is very heavy, is hauled to the factories usually in steel barges, the motive power being horses or mules. The banks of the Abary are unsuited for a towpath, so Mr. Gordon had built this unique motor-boat, which he christened the "Creation." It was simply a rough boat in which he had installed a topless and wheelless Ford car, the rear axle geared to the stern paddle wheel and the steering gear connected with the rudder. A small Negro boy served as chauffeur to this hydro-Ford and we sat in the shade and motored up and down the Abary in the utmost comfort.

Along the irrigation canals leading from the Abary caimans were found in considerable numbers even at this wet season, when the "savannahs" or plains were covered with two feet or more of water. On the banks or "dams" that confined the water numerous caiman nests were found, usually containing about twenty-five eggs each. Several of the caimans were killed as a part of the work of the expedition and their skulls or entire skeletons "roughed up" for the American Museum of Natural History. In cleaning the flesh from the bones advantage was taken of the aid of the buzzards and carrion crows, as had been done on other similar trips. The skins were removed and the carcasses were left exposed to the attack of these vultures, which soon cleaned the bones sufficiently for transportation.

It was most interesting to note the way in which the birds dropped from an apparently empty sky. It was two hours after the carcasses had been exposed before the first buzzard discovered them and made a wary survey of conditions; but in twenty-five minutes from the time that this first bird had begun to feed, sixty-five buzzards and carrion crows had dropped from the cloudless sky to hiss and fight over the bones,—which were pretty well cleaned of flesh at the end of that time. How many more birds would have arrived had the supply of food lasted it is hard to guess. It was fascinating and mysterious to see these great birds suddenly appear from nowhere.

While the rainy season of late spring and early summer is the time to hunt the recently laid eggs, the dry season is the time to study the caimans themselves, when the savannahs are dry and the animals are concentrated in great numbers along the canals and other water courses.

It would seem well worth while to study the habits of these "alligators" in British Guiana, especially as to their food, since it is likely that they may serve a useful purpose in the United States by destroying cane rats and other pests, as is the case with *Crocodilia* in other parts of the world.

The "Creation," a homemade motor-boat used for towing barges of sugar cane. The motive power is a topless and wheelless Ford car

The Discovery of the Chinese Takin

By MALCOLM PLAYFAIR ANDERSON

Professor Melville B. Anderson, of Leland Stanford Junior University, father of the late Malcolm P. Anderson, has placed the following manuscript by his son for publication in the columns of this magazine. The Chinese story by the same author in the January–February number was staged near the sacred mountain, Tai-pei-san, of 12,000 feet elevation, which forms the scene of the present hunting experience.—THE EDITOR.

I

THE takin, an animal nearly the size of a steer and perhaps related to the musk ox, has long been known from the mountains of southeastern Tibet, and another race from extreme western China. In 1910, while conducting the Duke of Bedford's Expedition, the author had the good fortune to discover a third species[1] in the mountains of northern China. As very little is known of the habits of any species of this animal, it seems worth while to put the experiences on record.

The late Malcolm Playfair Anderson, leader of the Duke of Bedford's Asiatic Expedition of 1910; he discovered a species of Chinese takin on the heights of the sacred mountain, Tai-pei-san

The precise locality of the discovery is on the heights of the sacred mountain called Tai-pei-san, rising to an altitude of more than twelve thousand feet in the Chin-ling range of the southwestern portion of the Province of Shensi. Tai-pei-san is not a mere peak but a group of summits, the ridges of which rise very steeply to form the isolated mountain mass, apparently much higher than other portions of the range. High up on this eminence exists a belt or zone of bamboo grass, the habitat of the takin.

With my companions, Smith and Ward, I had been staying awhile at the village of Ling-tai-miao, which lies in a cañon west of the great mountain. While engaged here in studying the birds and mammals of the vicinity, we heard reports from the natives of a strange animal called by them "pan-yang." Being too busy to search for the beast, we hired a hunter to shoot some specimens, stipulating that he should send notice promptly so that we might go out and skin the animals. One evening a messenger arrived with the news that two females had been shot. He said that the kill was near by and urged us to start at once for the mountain. As it was late and cold, I decided to wait until morning, and this was wise for, as will be seen, the carcasses lay on the other side of the mountain, where they could be reached only by dint of ten hours of the hardest climbing.

The next morning, guided by the

[1] *Budorcas Bedfordi*, described by Mr. Oldfield Thomas in Abstr. P.Z.S. 1911, p. 27 (May 2), and in *Proceedings of the Zoological Society of London*, pp. 693-95, from the specimens discovered by Mr. Anderson.

messenger, we all set forth, starting from the cañon bottom at an altitude of about three thousand feet, whence we ascended a grassy ridge intervening between the village and the lofty peaks, crossing a valley of considerable depth.

Then began the actual climb. The track followed was more a slide for timber than a trail and ran straight up the abrupt slope. Yet this was not so bad as long as we were on the bare frozen ground, but, upon reaching the snow in the forest, we found the trail all icy so that climbing in ordinary hobnailed footwear was next to impossible. This contingency having been foreseen, we now bound upon our feet some heavy iron spikes, a Chinese contrivance for the purpose, made for us by the village blacksmith.

There was no slackening of the slope until near the summit. We moved slowly but rose very rapidly, first through woods of small oak, then through the forest of spruce where there was varied undergrowth of bushes. Higher up, the bushes gave place to a thicket of small bamboo, called "bamboo grass," growing from six to twelve feet tall and as thick as it could stand. So dense was the thicket that it was impossible, going up, to force one's way through it; descending, one might ride it down, but only with great effort. Higher still, the spruce forest was filled with rhododendron and azalea bushes. Finally, leaving this below us, we came out on the mountain tops where the few trees and bushes were stunted.

During the latter part of the climb we all felt the effects of the altitude; Ward especially showed signs of fatigue and fell behind several times before we reached the lofty pass that had to be crossed. We waited in the divide until we saw him safely at the highest point, together with the man and the boy who carried our food; then, thinking all was right and that Ward would follow us without further difficulty, Smith and I went ahead, not suspecting that the carrier did not know the way.

Beyond the pass we descended over long stretches of talus till we reached the forest and the upper edge of the belt of bamboo grass again, at an altitude of about ten thousand feet. It was already twilight when we reached the camp of some coffin-board cutters, where we found our hunter awaiting us.

Tired and hungry, we watched for Ward and our provisions, but darkness fell and they did not arrive. I was for starting out to look for the stragglers, but Smith suggested that it would be useless and, on second thought, it occurred to me that our companion, having all the food, would be likely to fare better than we ourselves.

The sawyers had built a narrow little shelter by leaning some boards against the side of a cliff, and here a number of them were crowded about a scanty fire. In this poor, fragile cabin room was made for us, and we sat awhile, partaking, gladly enough, of some of the corn cake on which these wretched creatures live and which they were toasting in the ashes. Luckily we had our small blankets, so presently we went out under the stars in search of a place to sleep. The mountain-side being very steep, it was not easy in the dark to find a level spot, but at last we settled down. It was very cold on the frozen ground from which Smith and I made shift to scrape away the snow, and we lay shivering all night.

In the morning we were anxious to see the animals we had come so far to skin. Expecting that Ward would arrive in our absence, we left directions for him to follow, and set forth, without a morsel to eat, on what proved to be a long task. In the bamboo thicket below the sawyers' camp, on a very steep slope leading down to a frozen torrent, we found the first takin. I had thought it likely that I would know the animal when I saw it, but in this I was mistaken. Smith said it was a musk ox, but I knew better than that. We named it the "goat ox." It was a full-grown female of light sandy color all over, and of a size similar to that of a domestic cow, though much shorter in the legs and with a decided hump of the shoulders. The horns at once excited our curiosity,—these it was that had reminded us of the musk ox. They were not very long, arose close together from the brow, ran outward and downward for about eight inches, then turned sharply upward and backward. The tail is like that of a goat, short and bare on the under side. I noted especially that the side or false hoofs of all four feet were particularly large and well worn, as if they were useful to the animal. Probably this four-hoofed foot gives a good grip on rock surfaces, making it possible for the beast to traverse the precipitous places which it inhabits.

As has been stated, the takin frequents the thicket of "bamboo grass" on the leaves and shoots of which it feeds. Below this belt it does not descend, but frequently comes out upon the crags above the bamboo to browse the bunch grass that grows abundantly there. For an animal of such bulk and apparent unwieldiness, it is exceedingly swift and nimble in climbing over the rocks.

To skin such a large animal on the steep slope was a difficult matter, but we cut away the thicket to give us room and built a staging of poles out from the mountain-side for the carcass to rest upon. As it had frozen stiff, the task of removing the skin was far from easy. Into that deep, cold cañon the sun did not penetrate all that day. We finished skinning the first carcass about noon, when we turned it over to the Chinese woodcutters, who eagerly set about carving it up, saving all the blood and even the entrails, which they seemed to value more than they did the flesh.

As the second carcass lay upon an even worse slope where we had difficulty in keeping our foothold, we were obliged, at the risk of injuring the skin, to drag it down some distance until we had it securely at rest upon the upper side of a large spruce log. This was a very inconvenient place in which to work, and what with this and our fatigue and hunger and the intense cold, our progress was slow. The frozen flesh stiffened our fingers until we could not handle the knife, so that we had to stop frequently and thaw out our hands by a little fire we had kindled. By the time we had finished, the pale, wintry sunshine had faded from the cliffs above us.

Now arose the question whether we should remain another night or return at once to Ling-tai-miao. The Chinese thought us mad to talk of returning, and indeed the project was rather foolhardy, but, besides being famished, I was anxious to learn, if possible, what had become of Ward. We therefore decided to return.

Arrangements were made with the hunter to bring down the skins and skulls on the morrow, so we had nothing to carry with us but our roll of blankets. The coolie who had brought this up refused to accompany us back that night, but our chief muleteer, who had followed us up from the village, volunteered to take his place. Darkness was falling when we started up the talus slopes leading to the high pass; nor had we gone far when the muleteer found his burden too heavy. As I was more used to such a load than he was, he and I agreed, from that point on, to carry the pack by turns.

When my little party reached the divide, a very high wind struck us in the face with such force and so icily that we could hardly make headway. But we crept along from sheltering rock to rock as best we could and so arrived finally on a flank of the mountain where we were more shielded.

Meanwhile the full moon had risen high, lighting up from a clear sky such a scene as we had never looked upon before. To right and left rose snowy peaks, at our feet was a precipice, and far below us lay vast cañons filled with dark forest. By daylight it would not have appeared an unusual mountain scene, but in this enchanted light it was indescribably majestic. We paused awhile, forgetting that we were tired, shivering, and famished.

At midnight we two entered our inn at the village and were relieved to find Ward in his bed. He also had had a hard time, for the porters had been unable to find the way, and had wandered off down some spur of the mountain. At night they had found a place somewhat sheltered from the wind and had built a fire. Then the Chinese, opening the bag of provisions, had offered Ward bread, but he, not understanding them, and not knowing that the food was ours, was too proud to accept. So he too had gone hungry, although watching the men eat his own provisions.

II

On another occasion I became more closely acquainted with the takin of Tai-pei-san.

My friends and I decided to hunt the animal ourselves. As it was the coldest part of the winter, we made careful preparations. Hiring two native hunters as guides, and some other men to carry our blankets and supplies, we started out for a stay of several days.

On the morning of January 8 we began the ascent, following the trail as before, and it was near nightfall when we reached a point near the upper edge of the belt of bamboo grass. We had brought no tent because our chief hunter, Yang, had told us of a cave that we could camp in. This, however, proved to be, instead of the real cavern we had expected, merely an overhanging cliff affording no very good shelter. It was at the head of a deep and narrow cañon at an altitude of ten thousand feet in the spruce forest and surrounded by the thick undergrowth of bamboo.

In this shelter, such as it was, my friends and I took the part next the wall of rock, while the Chinamen built a large fire near the outer edge. Wrapping ourselves in sheepskin robes we spent the night in our blankets—but the men sat all night by the fire, dozing and talking at intervals. So they passed not only this first night but all the nights we remained there. On our previous expedition we had observed that the poor coffin-cutters passed their nights in the same way, their narrow shelter of boards giving them no place to lie down. It was a wonder to us that they should be able to do what they did on so little sleep. Reflection upon what we observed led us to the conclusion that their fatigue was merely muscular, rather than mental or nervous, and that they could rest standing, if necessary, like so many horses.

We awoke in the morning to find ourselves surrounded by a thick fog, while a light snow was falling. As our hunters assured us that it was useless and dangerous to go out, we remained near the shelter all day, preparing the skins of a few mammals we had trapped during the night. Toward evening, as the fog began to thin, Smith and I, feeling the need of exercise, climbed a thousand feet farther up the mountain. Getting out of the fog for a time, we were rewarded for our exertions by magnificent views of valleys below us and of various spurs and ranges standing out of the enveloping mist and bright in the setting sun.

The third day was far better, the sky being clear and the fog lying sea-like thousands of feet below us. The flanks of Tai-pei-san formed a rugged coast line which, from our lofty point of vantage, the eye could follow into the distance. Few other mountains of our range were of sufficient elevation to appear, although, far beyond, peaks stood above the clouds. Observing this, we were impressed with a sense of the distance by which Tai-pei is separated from the heights to the westward.

We had intended to begin our search by early dawn, but Yang and his men were slow in getting started. This made us restless, not yet knowing, as he did, that the takin is a diurnal animal. At last we made our way up the rocky slopes to a saddle which, as my barometer told me, had an elevation of twelve thousand feet and upward. Here among the rhododendron bushes above the zone of bamboo the hunters laid down their matchlocks side by side, and Yang prepared to pray to his ancestral spirits and to the God of the Mountain. First lighting several sticks of incense and sticking them up in the snow, he burned a sheet of yellow paper beside them. In his prayer, which was long, he told the spirits all about us and our hunting trip, and how he had brought us there to hunt the pan-yang, and he prayed that we might speedily find those animals. After the prayer he spent a long time in repeatedly tossing up two pieces of wood, evidently desiring to work some charm. These blocks were horn-shaped, flattened on one side, ridged and grooved to fit together; apparently he would not be satisfied until they fell in a particular way. He would try and try, then pray awhile and try again; then he would work a little over the guns, change their positions, and try once more. If his perseverance was rewarded with success there was no sign of it from him or his men. At last, when our patience was nearly exhausted, Yang pocketed the sticks and rose from his squatting position, took each gun in turn, passed it first under one leg, then under the other, and handed it back to the owner. Then they were ready to hunt.

While two of the hunters went down one side of the divide, my companions and I followed Yang down the big ridge through the forest and over rocks and ledges, finally reaching a projecting cliff from which was an outlook in several directions. From this point, after a careful scrutiny of the mountain-sides, we at last caught sight of the game. Deep down below us, feeding among rocks and precipices, was a whole herd looking like a herd of cattle.

I was for stalking them at once, but Yang wished the other two men to participate and I yielded to him. So we made a long detour to the other side of the ridge and, after much whistling, our signals were answered from far below. When, on the arrival of the other fellows, I learned that they had been on the track of a goral, I wished that we had left them alone. The greater

Bedford's Chinese takin, discovered by Mr. Malcolm P. Anderson in 1910, on the heights of Tai-pei-san, northern China. From a drawing in color by H. Goodchild in *Proceedings of the Zoological Society of London*, Vol. II, 1911 part of the day had passed and we had done nothing more than locate our game. Crossing back to the point whence we had seen the herd, I took advantage of a few minutes' rest to question Yang about the habits of the takin. According to him they always go in herds; this herd, he said, contained about forty individuals. When alarmed they will stampede, always running down the mountain, but if prevented from doing this they will charge the hunter and prove very dangerous.

After a long and difficult descent across rock slides where it was hard to keep from setting stones in motion, thus alarming our game, we at length reached the spur where the herd was feeding. It was just a short, forested shoulder terminating in rocks and spires, and dropping off in a great precipice.

We had not seen all the animals from above. Just as Yang had told us, there was a large herd of these sandy-hued cattle browsing the bunch grass which grows among the crags. They were so big and seemed so clumsy that it was astonishing to find them there in a situation apparently better suited to the chamois or the mountain goat.

First cautioning us not to get into a position where we might be charged, Yang led his men off in one direction, while Smith and Ward followed me in another. We advanced, creeping behind rocks and trees, following around the face of a steep cliff until we reached a rock beyond which we could not go without alarming the game. Peering cautiously over this rock, I saw the heads of several animals which were quietly feeding not far away, but I did not choose to shoot at the heads because I wished to preserve the skulls intact. Ward and Smith, who were not armed for such large game, stood behind whispering to me to shoot. I think the takin must have heard their voices; at any rate, while I was waiting for the shot I wanted, the animals grew restless and alert. Fearing, therefore, that they would escape me altogether, I at last fired at the largest one, intending to break his spine; but I must have shot high.

At this the herd stampeded. Most of them disappeared down slopes invisible to us, but to our surprise some of them ran down the steep slope of huge broken rocks which lay in front of us, displaying an agility not to be expected in a beast so ungainly. As they bounded from rock to rock I shot four times at them without effect. Then, seeing a large bull running down the cañon to my left, I shot again, whereat he turned a double somersault down the steep. But in a trice he was on his feet again and running. We leaped down the talus slope and followed, thinking to come across his body at any moment, but found nothing, although we searched long. We climbed back to where he had rolled, finding the broken bushes and plowed up stones, earth, and snow, but no bloodstains. Amid so many crossing tracks it was impossible to follow any one.

We took our way back to camp, dejected, but before reaching it we heard a shot followed by a great shout. An hour or so later our hunter made his way up the cañon to camp to announce that he had followed a large bull to a point in the bamboo thicket below the "cave," and there had killed him with one shot.

The game was secured. With his homemade matchlock the native huntsman had outdone me and my high-powered rifle.

Mammal Fur Under the Microscope

The remarkable structural forms seen in the hair shafts of animals.—A department of knowledge not alone of zoölogical significance, but applicable also for standardizing furs and fabrics in the industries

By LEON AUGUSTUS HAUSMAN

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THE microscopic units in the structure of the hair of the various species of mammals present a multitudinous array of diverse forms. These microscopic structures in the hair shaft are so constant in form and in relationship among species and groups, that an accurate knowledge of them and of their interrelationships may contribute toward the solution of many problems, not only in pure zoölogical science, but also in the fields of certain important industries in which animal hairs are employed.[1]

What are the separate structures, so minute that the unaided eye cannot detect them, that go to make up a hair? The early writers and investigators supposed that the hair was a solid, horny cylinder, transparent, or at least translucent, throughout its length, and devoid of any definite internal structure. From a study of the hair today, with our powerful microscopes and modern microscopical equipment, we are able to determine with accuracy that each hair is a complex structure, and made up of well-defined elements.

The Life Story of a Hair

The hair begins its growth as a localized increase in the number of cells of the outermost layer of the skin, the layer called the epidermis, forming a dense aggregation of cells which elongates downward into the true skin or dermis beneath (see illustration of hair in its natural position as when growing in the skin, page 436). Directly beneath this downward-elongating depression of the cells of the epidermis there is formed a dense mass composed of the cells of the dermis, which ultimately becomes the papilla of the hair. The flask-shaped depression becomes lined with cells from the epidermis, and is known as the follicle. All future growth of the hair is confined to the bulbous lower portion of the shaft, where the conversion of cells of the follicle into horny hair-shaft cells is continually in progress during the lifetime of the hair.

Mammal hairs are in general either circular or elliptical in cross section. Those which are circular are straight or but slightly curved, while those of elliptical cross section are curly or kinky, the amount of curl being dependent upon the flatness of the ellipse.

The General Structure of the Hair Shaft

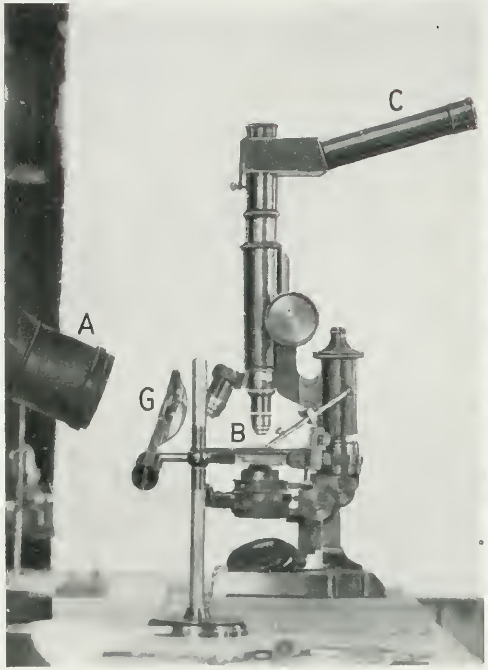
The hair shaft itself is built up of four well-defined structural units (see illustration of greatly magnified hair, page 436):

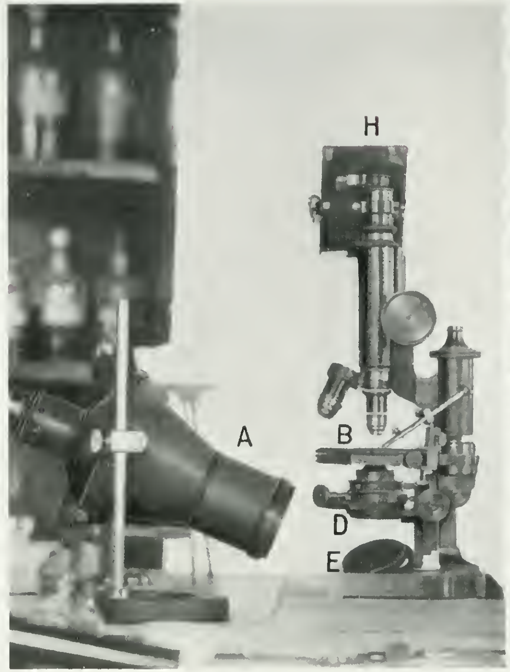
(1) The *medulla* or pith, which is composed of many shrunken and variously disposed cells or chambers, representing dried and horny epithelial structures, and often connected by a filamentous network, which may either completely or only partly fill the medullary column.

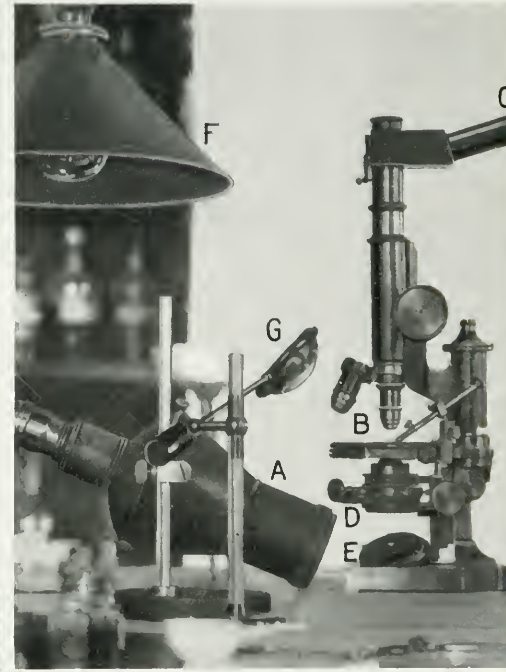
(2) The *cortex*, surrounding the medulla, and composed of spindle-shaped cells, coalesced into a horny, almost homogeneous, transparent mass, and forming, in those hairs wherein the medullary element is reduced, a large proportion of the hair shaft.

(3) The *pigment granules*, to which the color of the hair is primarily due. In some cases, however, the coloring matter of the hair shaft is diffuse and not granular in form, but in the hair of the greater number of mammals the color results from the distribution within and among the cells of the

[1] For the industrial applications of the study of mammal hairs, see: Hausman, L. A., "The Microscopic Identification of Commercial Fur Hairs," *Scientific Monthly*, Jan., 1920; "Structural Characteristics of the Hairs of Mammals," *Am. Naturalist*, in press. "Hairs That Make Fabrics," *Scientific American*, Feb. 21, 1920; "Fabrics Under the Microscope," *ibidem*, in press; "The Detection of Imitation Furs," *ibidem*, in press.







THE AUTHOR'S EQUIPMENT FOR STUDY OF MAMMAL HAIRS

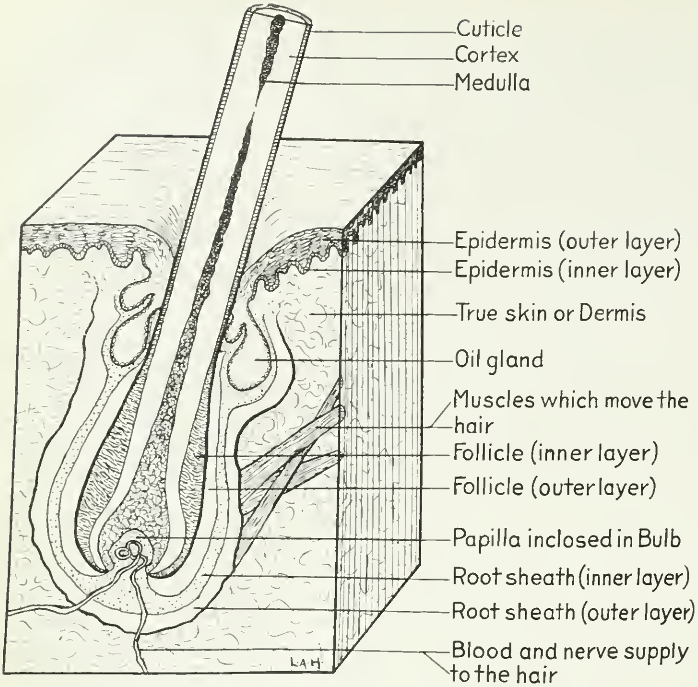
A microscope with the usual series of lenses in the upright tube, and an extensible eyepiece at C, above a small "stage" (B) on which the hair to be examined is mounted (there is a round perforation at the center of the stage); a microscope lamp (A), condensing lens under the stage (D), a round adjustable double mirror at the base of the microscope (E), an additional tungsten lamp (F), and an additional condensing lens movable on a separate stand (G).

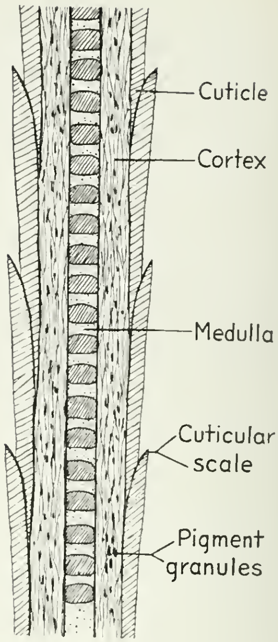
For the satisfactory examination of mammal hairs under the microscope two types of illumination are required.

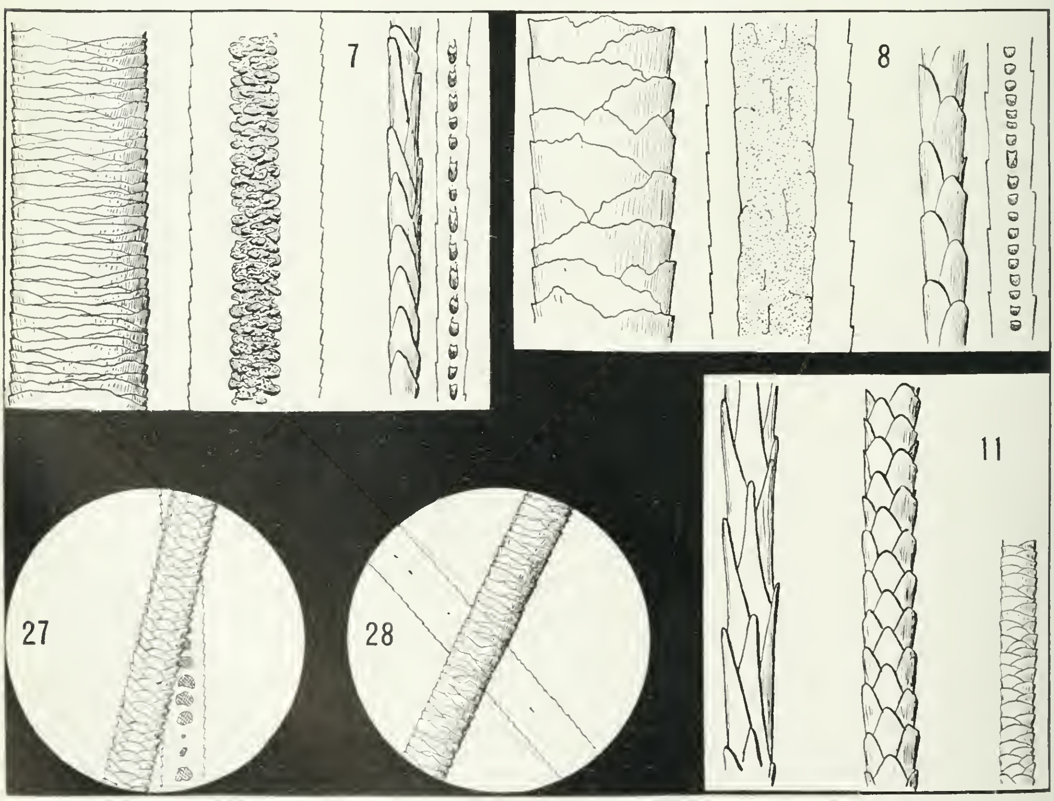
At the left is shown the arrangement of the apparatus for examination of the hair with direct light on a dark field (the hole in the stage is covered with a piece of black velvet). The light is directed from *A* through the condenser *G* to the object at *B* (and viewed, of course, through the eyepiece)

In the middle the equipment is arranged for examination of the hair by transmitted light; that is, light from *A* is thrown on the mirror *E*, which reflects it upward through the substage condenser *D*, and by way of the opening in the stage through the object at *B*. Transmitted light shows the hair in optical section and is accordingly useful for studying the medulla. A camera lucida (*H*) allows an exact tracing of the object to be made

At the right the arrangement of apparatus allows examination by both direct and transmitted light; (1)—Light from *F* passes through the condensing lens *G* and is focused directly upon the object at *B*. (2)—Light from *A* passes through the object at *B* by way of the mirror *E*, the substage condenser *D*, and the opening in the stage. Photomicrographs may readily be taken with each of these types of illumination, accentuating different features as shown on page 444


Cuticle
Cortex
Medulla
Epidermis (outer layer)
Epidermis (inner layer)
True skin or Dermis
Oil gland
Muscles which move the hair
Follicle (inner layer)
Follicle (outer layer)
Papilla inclosed in Bulb
Root sheath (inner layer)
Root sheath (outer layer)
Blood and nerve supply to the hair
LAH


Cuticle
Cortex
Medulla
Cuticular scale
Pigment granules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28

cortex of minute particles of some pigment. These particles are arranged in the different hairs in fairly definite and characteristic patterns, and may often serve as aids in identification.

(4) The *cuticle*, or outermost integument of the hair shaft. This is composed of thin, transparent, and colorless scales of varying forms and dimensions, arranged in series, sometimes overlapping like the shingles on a roof or the scales on a fish.

Fur Hair and Protective Hair

Most mammals possess at least two kinds of hair—a short, thick, fine coat next the skin, which is termed the fur hair or the under hair, and a longer, coarser, usually stiffer hair, which overlies the first, and to which has been given the name protective hair, or over hair. It is the first-named hair, the fur hair, which usually forms the greater part of the body covering (see 27 to 88, pages 436–443, in each of which two shafts are shown, the one treated to show the medulla, the other to show the cuticular scales). In the fur hair and protective hair from the same animal the cuticular scales and medullas differ (for example see hair of the European beaver and of the skunk, Nos. 7 and 8, on opposite page), and these characters can therefore be used to distinguish the two kinds of hair when only small fragments are to be had, or when the hairs have been clipped or dyed, as they frequently are when made up into furs. Some animals, like the duckbill or platypus and the spiny anteater, possess a great many different modifications of these two kinds of hair, each one in most respects quite unlike the others.[1] This is rarely the case, however, among other mammals. Of each of these two main kinds of hair there are two varieties:

(1) Hair in which there is a simple medulla consisting of a relatively small shaft with a single central column or a rod of separate cells (see 85 and 69, page 443).

(2) Hair in which there is a compound medulla consisting of a somewhat larger shaft with two, three, or even four longitudinal, parallel columns of small, separate medullary cells (see 80 and 81, page 443), showing hairs of the pocket rat and the Cape jumping hare). Hair with compound medulla is comparatively rare.

A glance at the numerous figures of magnified hair shafts presented with this article[2] shows the existing wide variety in form of the medullas and cuticular scales. These figures indicate the nature of the scales and medullas as they appear one third the distance from the base to the tip of the hair shaft. Here it is that, ordinarily, the medulla reaches its greatest expansion, and the cuticular scales show their forms most fully developed. Farther along in the direc-

[1] Hausman, L. A., "A Micrological Investigation of the Hair Structure of the Monotremata," *American Journal of Anatomy*, September, 1920.

[2] For the use of these figures, as well as of several others in this paper, the author is indebted to the *Am. Naturalist*, which has kindly allowed their reproduction from his paper, "Structural Characteristics of the Hairs of Mammals."

Description of upper figures on opposite page.—The microscopic anatomy of mammalian hair presents features that are constant for different species and groups. The hair forms accordingly permit of systematic classification and make possible the identification of any given specimen as that of a certain animal, a fact which is of obvious practical importance in the detection of substitutes for commercial furs. These two drawings depict the generalized microscopical structure of a hair in its follicle (at the left) and of the hair shaft (at the right, greatly magnified). After a hair is started, the new growth occurs only at the bulb in its root where there is connection with a blood and nerve supply.

Description of lower figures on opposite page.—The form of the scales varies somewhat in different regions of the hair shaft probably because of increasing wear toward the tip. This is well shown in the illustration of the hair of the duckbill (11), the sections taken from near the skin (at the left), midway to the tip (middle), and near the tip.

Most animals possess a short thick coat of fine fur hair next the skin and an overlying coat of coarser "protective hair." These two types are figured for the European beaver (7) and the skunk (8). The two large hairs on the left in each instance are the protective hairs, treated to show the cuticular scales and the medulla, respectively; on the right are two fur hairs similarly treated. Figure 27 shows the unusual regularity in geometrical design of the scales on the fur hair of the black lemur. The hair drawn in Fig. 28 was taken from the remains of a mammoth (*Elephas primigenius*) found in Alaska.

The platypus or duckbill of Australia (*Ornithorhynchus anatinus*) is a creature which is partly aquatic, partly subaërial, and partly subterranean. It is furnished with many different varieties of hair; namely, fine long hair on the chin; the finest hair of the body about the ear; posterior to these, short, stiff hair, rather flattened; long, stiff, flattened hair on the under portion of the body; very stiff, almost bristle-like hair on the wrists; and long, soft, dark brown hair on the back. Besides all these different sorts of hair, the platypus also possesses still another type, the fur hair, underneath the long brown hair of the back. (Drawing from Kingsley's *Natural History*)

tion of the free extremity of the shaft the medulla usually becomes reduced, broken up into fragments, or pinched out altogether. The cuticular scales, likewise, undergo a progressive alteration of form as the tip of the hair is approached, owing probably to the increasing amount of wear upon their free edges. This is remarkably well illustrated in the hair of the platypus, in which the scales may be very long and pointed at the base of the hair, reduced to an oval form midway in the hair's length, and to flat, even-margined scales toward the tip (see 11 in illustration on page 436).

All of the fur, or all of the protective hair, even, of any given individual animal is not of exactly the same diameter: hair varies in this regard considerably, differing in the range of variation among different species of mammals, and a somewhat less range of variation occurs in the averages of the diameters of the hairs of different individuals of the same species. Hence, too much importance cannot be attached to hair magnitudes, except, possibly, when dealt with in large averages, and between large groups, for example, families or genera. Inasmuch as the hair shafts figured here vary in diameter from 6.80 microns to 160.00 microns,[1] to show them to the same scale, and at the same time to make the smaller hairs of sufficient size to represent clearly the cuticular scales and medulla, was obviously impracticable. The arbitrary expedient was therefore adopted of representing all the hairs whose diameters were equal to, or less than, the average diameter of the human head-hair (roughly 51.00 microns) as one standard size; and of representing all those hairs whose diameters were greater than that of the human hair as of another standard size. The latter hairs are represented as being only slightly larger than the former. In order that an appreciation might be had, however, of both the relative and actual magnitudes of the hairs in the figures, the average diameter of the fur hair of each species is given in microns after the name.

Mammal Hairs Identified and Classified by Means of the Cuticular Scales[2]

A comparison of the various cuticular scales exhibited by mammalian hairs shows that they may readily be assigned to two great groups:

(1) Imbricate—Those that lie singly, overlapping about the hair shaft, and

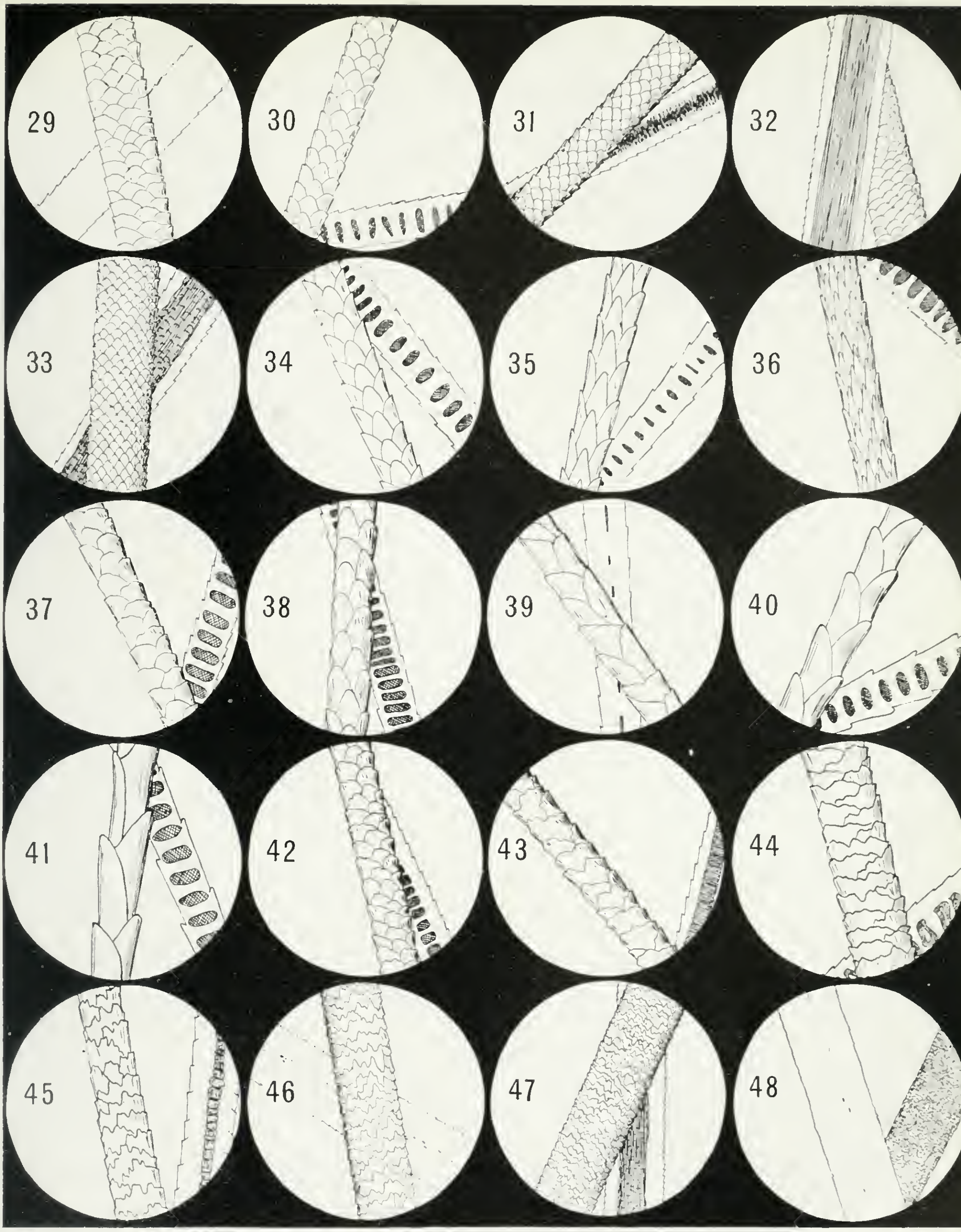
(2) Coronal—Those that encircle the shaft as a continuous band with a resemblance in some instances to the shape of a coronet.

The simplest form of the imbricate scale is the ovate type, shown in the hair of the yellow-haired porcupine (29). In four other examples of this type, including the pronghorn and True's white-tailed deer, the scales undergo a diminution in size and an increase

[1] One micron is 1/1000 of a millimeter, or about 1/254000 of an inch.

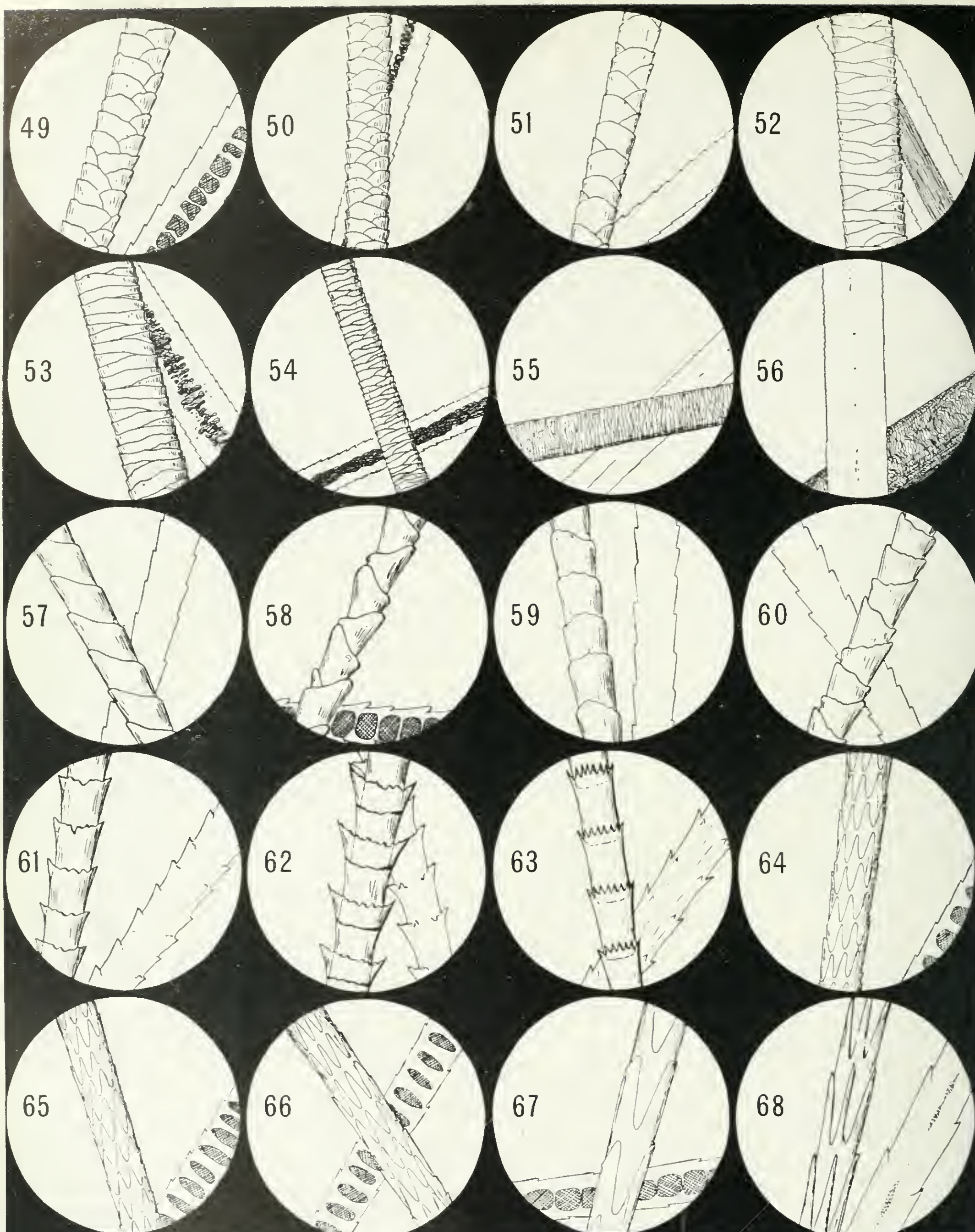
[2] Classification of forms of cuticular scales of the mammalian hair (see pages 439 and 440):

- I. Imbricate
  1. Ovate—Five varieties, 29 to 33
  2. Acuminate—Three varieties, 34 to 36
  3. Elongate—Five varieties, 37 to 41
  4. Crenate—Seven varieties, 42 to 48
  5. Flattened—Eight varieties, 49 to 56
- II. Coronal
  1. Simple—Two varieties, 57 and 58
  2. Serrate—Five varieties, 59 to 63
  3. Dentate—Five varieties, 64 to 68



The series of highly magnified hair shafts presented here and on pages 440 and 443 have been selected to exhibit different arrangements of the cuticular scales and medulla. (The measurements below are expressed in microns)

(29) x134 Yellow-haired porcupine (*Erethizon spixanthus*) 59.50
(30) x294 European mole (*Talpa europaea*) 17.00
(31) x167 Tibetan sun bear (*Helarctos thibetianus*) 30.60
(32) x79 True's white-tailed deer (*Odocoileus truei*) 102.00
(33) x79 American pronghorn (*Antilocapra americana*) 102.00
(34) x167 Pocket gopher (*Geomys tuza*) 29.10
(35) x186 Rabbit bandicoot (*Peragale lagotis*) 27.20
(36) x417 Baird's shrew (*Sorex bairdi*) 12.00
(37) x334 Lowe's tree shrew (*Ptilocercus lowii continentis*) 15.00
(38) x218 Tree shrew (*Dendrogale frenata*) 32.00
(39) x186 Three-toed sloth (*Bradypus tridactylus*) 27.20
(40) x357 Giant golden mole (*Chrysochloris trevelyani*) 14.00
(41) x385 Golden mole (*Chrysochloris leucorhina*) 12.50
(42) x250 Tana (*Tana chrysura*) 20.00
(43) x167 Patas monkey (*Cercopithecus patas*) 31.00
(44) x113 Titi (*Callithrix jacchus*) 80.00
(45) x60 Tenrec (*Centetes ecaudatus*) 100.00
(46) x104 Peba armadillo (*Tatu novemcincta*) 76.50
(47) x79 Percheron mare 101.00
(48) x37 Dalmann's pangolin (*Pangolin dalmanni*) 220.00



The scales on the hair of the lion (52) are typical of the scutellation on large coarse hairs while the compact scales of the naked mole mouse (56) are characteristic of spines and bristles and the hair of animals sparsely covered. In the case of bats the scales show exceptional beauty under the microscope. The dentate forms appear most frequently among the carnivores and rodents. (The measurements below are expressed in microns)

(49) x156 Restless cavy (*Cavia porcellus*) 45.00
(50) x167 Sagouin (*Hapale penicillata*) 30.00
(51) x192 Opossum (*Didelphys marsupialis caucae*) 25.50
(52) x108 Lion (*Felis leo nyanzae*) 74.00
(53) x59 Northern sea lion (*Eumentopias stelleri*) 153.00
(54) x267 Spectral tarsier (*Tarsius tarsius*) 15.00
(55) x98 Apar (*Tolypeutes conurus*) 51.00
(56) x104 Naked mole mouse (*Heterocephalus glaber*) 77.60
(57) x556 Red bat (*Lasiurus borealis*) 8.50
(58) x278 Malay vampire bat (*Megaderma trifolium*) 18.00
(59) x455 Musky bat (*Noctilio leporinus*) 11.00
(60) x500 Phyllops (*Phyllops falcatus*) 10.00
(61) x556 Mastiff bat (*Molossus sinaloae*) 9.00
(62) x556 Wrinkled-lipped bat (*Nyctinomus bocagei*) 8.50
(63) x714 Intermediate bat (*Mormops intermedia*) 6.80
(64) x314 Chinchilla (*Chinchilla lanigera*) 16.00
(65) x357 Scale-tailed squirrel (*Anomalurus peli*) 13.60
(66) x353 California sewellel (*Aplodontia californica*) 17.00
(67) x455 Mink (*Mustela vison aestuarina*) 11.30
(68) x556 European otter (*Lutra vulgaris*) 8.50

in numbers (see 30 to 33, page 439). A second type of imbricate scale, in which the apex tends to become more pointed, is illustrated in the hair of the pocket gopher (34). And there are other modifications (35 and 36) of this acuminate type which are well defined and evidently characteristic in general of the moles and shrews (Insectivora). Of particular interest is the very appreciably acuminate form shown in the hair of the Baird's shrew (see 36).

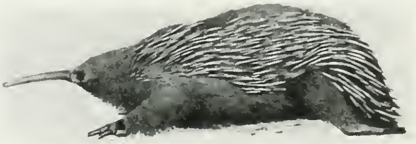
The elongate type of imbricate scale (37 to 41) is a rather uncommon form, particularly in its enlarged modification, as in the hair of the golden mole (41). The crenate type is very common, indeed it is believed that this is the predominant form of cuticular scale of mammal hairs. The hair of the tana (42) exhibits what we have called the simplest form of this type, a form which is to be distinguished from the ovate type of scale by the irregularity of the free edges of the scales. From this variety to the extreme form shown by the hair of the Dalmann's pangolin (48) there are a multitude of intermediate gradations. A very common form of the crenate type is that exhibited by the hair of the peba armadillo (45).

Second to the crenate sort of imbricate scale in frequency of occurrence, is the flattened type (49 to 56). The hair of the restless cavy (49) shows the form of scale which reveals its relationship to the simple ovate scale. The progressive flattening of the scales produces various intermediate modifications (50 to 56). The modifications represented by the hair of the lion (52) and by the hair of the Steller's sea lion (53) are those which we find usually associated with large coarse hairs, while stiff spinous hairs and spines nearly always exhibit a closely compacted modification of this form, similar to that shown by the hair of the naked mole mouse (56). It is interesting to note that, as in the case of the species just mentioned, wherever the hair of an animal is very sparse (whether it is spinous or not), there is usually encountered this type of closely compacted, flattened scale. The greater number of the species of the Primates (monkeys, apes, etc.) exhibit scales formed very much like those of the spectral tarsier (54).

The coronal scale (57 to 68) appears not to be subject to so many, or so diverse, modifications in form as does the imbricate scale. Three well-marked types can, nevertheless, be distinguished: (1) Simple, as in the hair of the red bat and Malay vampire bat (57 and 58); (2) Serrate, as in the hairs of the musky bat, *Phyllops*, mastiff bat, wrinkled-lipped bat, and intermediate bat (59 to 63); (3) Dentate, as in the hairs of the chinchilla, scale-tailed squirrel, sewellel, mink, and otter (64 to 68). The simple and serrate varieties are characteristic of the bats (Chiroptera), and their beauties under the microscope never fail to excite admiration.

The dentate coronal scale in its extreme form, as seen in the hair of the European or the American otter (68), is a scale of much beauty, rivaling the scales of some of the bats. The form of the coronal type most frequently encountered is that shown in the

This terrible panoply of spears borne by the spiny anteater (*Tachyglossus*) seems to indicate that its owner is one of the foremost advocates among mammals of aggressive militarism, yet such is not the case. The armament is purely for defense, and the creature confines its depredations to ant hills and colonies of other small insects. Nine different types of spines and spiny hairs are to be found upon the body



Another species of spiny anteater, *Zaglossus bruijnii bruijnii*, which possesses a greater amount of hair than the *Tachyglossus* and a smaller number of spines.—Note the abundance of fine hairs even between the spines on the sides of the body and the totally spineless area along the mid-dorsal line (photograph from Toldt) hairs of the scale-tailed squirrel and the sewellel (65 and 66). This type occurs with great frequency among members of the flesh-eating (Carnivora or Feræ) and gnawing (Glires) groups of mammals.

Hairs of Mammals Identified and Classified According to the Medullas

The medullas of mammal hairs fall naturally into three types, not quite so sharply differentiated, however, as the types of cuticular scales. The groups are, nevertheless, well marked, and are as follows:

(1) Discontinuous, in which the medulla appears as a column of isolated cells of regular pattern and placement (as in 34).

(2) Continuous, in which the medulla is in the form of an apparently more or less solid rod (as in 32).

(3) Fragmental, which is a form of medulla (86) probably resulting from the gradual breaking down of the second or continuous type.

The medullas, like the cuticular scales, undergo an immense number of intricate variations[1] among the different species. A glance at the figures from 27 to 88 will afford some notion of the number and nature of these various formal modifications.[2]

The simple discontinuous ovate medulla (69 to 72) is the most common medulla encountered. The flattened medulla (76 to 79) seems to be the next in frequency of occurrence, and the elongate medulla (73 to 75) the last. Compound medullas, such as those shown in the hairs of the pocket rat and Cape jumping hare (80 and 81), are uncommon. Many of the rabbits (Leporidæ) exhibit such hairs. Two varieties of this type of hair can be differentiated on the basis of the shape of the individual medullary cells or chambers (80 and 81).

The continuous medulla either exhibits traces of its coalesced medullary cells along the column or is homogeneous. The first or nodose variety is shown in the hairs of the opossum, roe deer, and great anteater (82, 83, and 84), and the second in the hair of the reticulated giraffe (85). These two varieties, and more especially the latter, seem to be characteristic of the split-hoofed group of mammals (Bovidæ).

The fragmental medulla deserves mention quite by itself. It appears to be derived by the breakdown of the continuous homogeneous medulla (85), and all the gradational stages of such a suppositive breakdown can be found, extending from such a form as that shown by the hair of the Sumatran rhinoceros (86) through various other more reduced forms (87 and 88), to no medulla at all (see 57). Not infrequently irregular masses of displaced medullary cells are encountered in hairs otherwise exhibiting no appreciable medulla in the usual location in the shaft.

General Observations

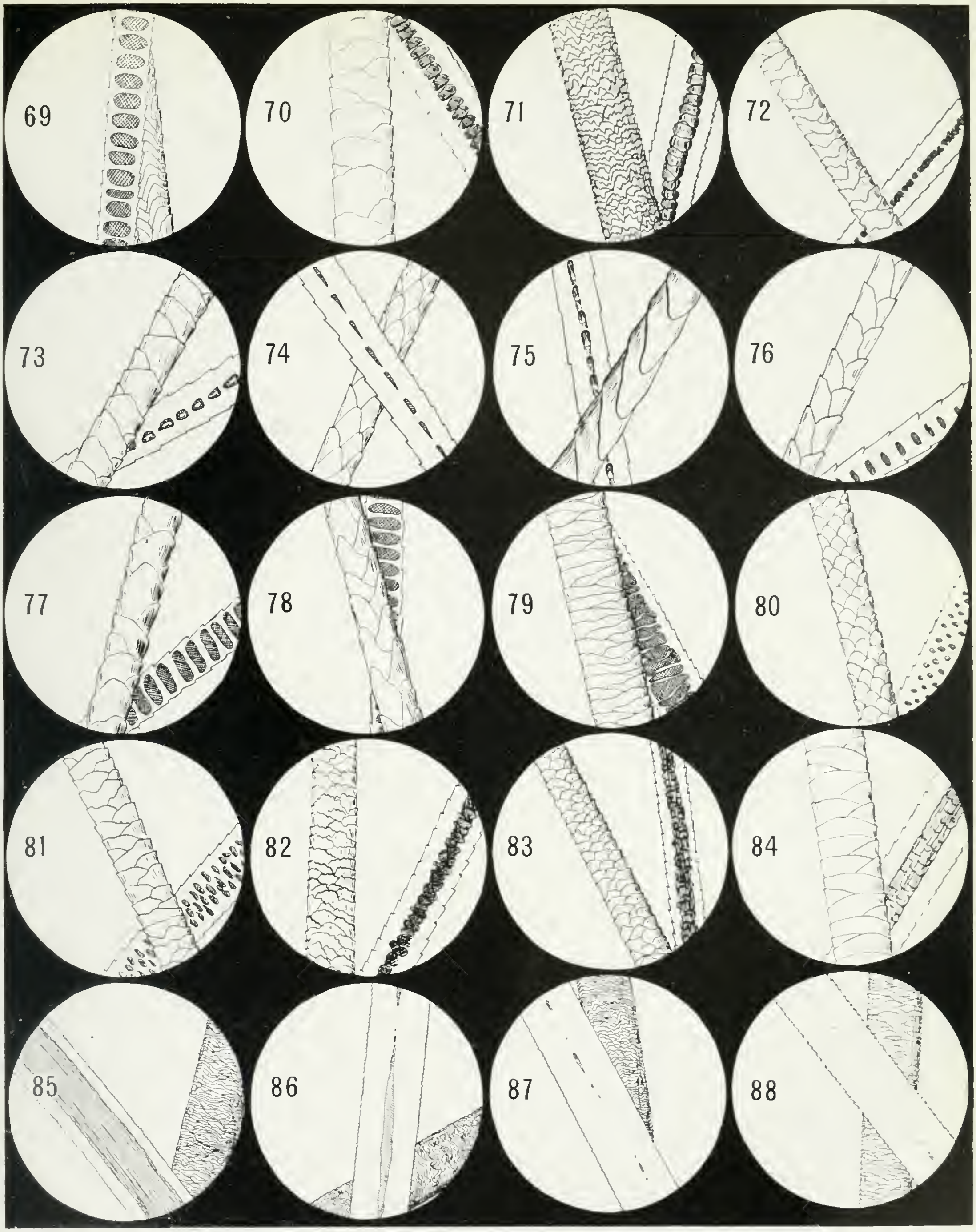
As a rule, those hairs of the least diameter exhibit, relatively, the largest cuticular scales, and conversely, those of the greatest diameter, the smallest scales. Again, in the case of the very largest and most rigid of hairlike structures, the spines, such as those, for example, borne by the spiny anteaters (see page 441), the free outer edges of the scales (at least upon the distal three fourths of the shaft) are usually worn down to such a degree that the outlines of the individual scale edges are no longer visible, and the surface of the spine presents a smooth, glossy, polished appearance. Where such conditions occur, scales more or less unmodified by attrition are usually discoverable at the base of the spine, just above, or beneath, the mouth of the follicle.

The fact that the free outer edges of the

[1] Classification of the forms of medullas of mammalian hair (see page opposite):

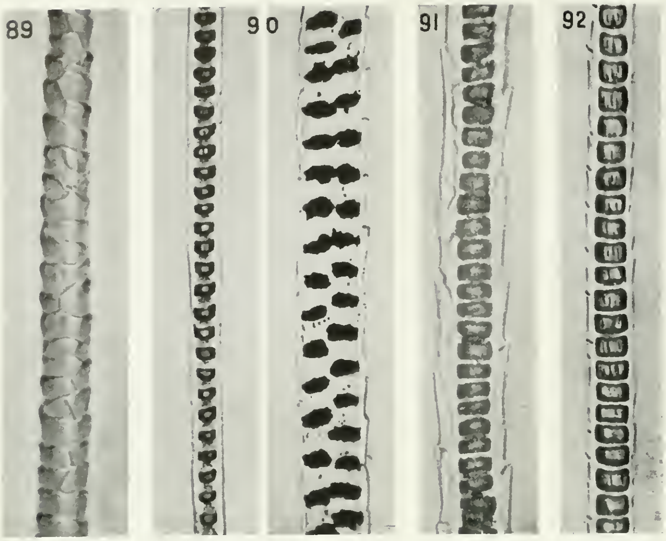
- I. Discontinuous
  - A. Simple
    1. Ovate—Four varieties, 69 to 72
    2. Elongate—Three varieties, 73 to 75
    3. Flattened—Four varieties, 76 to 79
  - B. Compound
    1. Ovate—80
    2. Flattened—81
- II. Continuous
  1. Nodose—Three varieties, 82 to 84
  2. Homogeneous—85
- III. Fragmental—Three varieties, 86 to 88

[2] However much two hairs from two different species of mammals may look alike, a comparison of the scales, medulla, pigment granules, relative and actual dimensions, and interrelationships of these elements will not fail to reveal constant and appreciable differences.



The medulla, or central pith, composed of columns of cells and air spaces, presents numerous patterns susceptible of use in the identification of hairs. (The measurements below are expressed in microns)

(69) x263 Gundi (*Ctenodactyles massoni*) 19.00
(70) x120 Cuon (*Cuon alpinus*) 75.00
(71) x114 Hedgehog (*Erinaceus hindei*) 98.75
(72) x294 Woodchuck (*Arctomys Monax*) 17.00
(73) x231 Short-nosed bandicoot (*Parameles obesula*) 25.50
(74) x250 Racoon (*Procyon lotor*) 20.40
(75) x546 European beaver (*Castor fiber*) 11.30
(76) x294 Deer mouse (*Peromyscus leucopus*) 17.00
(77) x217 Lerot (*Eliomys nagtglassi*) 23.00
(78) x313 Strand mole rat (*Bathyergus maritimus*) 15.50
(79) x52 California sea lion (*Zalophus californianus*) 153.50
(80) x192 Pocket rat (*Thomomys nevadensis*) 25.50
(81) x222 Cape jumping hare (*Pedetes caffer*) 27.20
(82) x171 Opossum (*Didelphys virginiana*) 40.80
(83) x50 Roe deer (*Capreolus capreolus*) 100.00
(84) x59 Great anteater (*Myrmecophaga tridactyla*) 136.00
(85) x160 Reticulated giraffe (*Giraffa reticulata*) 50.00
(86) x53 Sumatran rhinoceros (*Ceratotherium sumatrensis*) 152.00
(87) x50 Hippopotamus (*Hippopotamus amphibius kiboko*) 160.00
(88) x114 Borneo porcupine (*Triohys lipura*) 70.00



Photomicrographs of mammal hairs.—(89) Wool from the American Shropshire sheep, showing the imbricate cuticular scales. This hair was photographed by a combination of reflected and transmitted light (see figure at the right on page 435); mounted in air only.

(90) Fur hair from the back of the common house mouse (*Mus musculus*), viewed by transmitted light (see middle figure on page 435); hairs mounted in oil of amber. The hair at the left has a simple medulla; that at the right, a compound medulla. Note the enlarged character of the medullary cells of the latter and their irregular outline.

(91) Fur hair from the civet cat (*Arctogalidia fusca*), mounted in oil of amber and viewed by transmitted light.

(92) Fur hair from the gray rabbit (*Lepus nutalli mallurus*), mounted in oil of amber and viewed by transmitted light

A study of the structures and identification characteristics of animal hairs, formerly of interest merely because of its zoölogical significance, is rapidly becoming applicable in industrial fields as well, and particularly at present in the field of the fur trade, for it is now possible so to clip, dye, pull, and otherwise alter furs of certain types that their original appearance is entirely lost, and they may be sold under names not their own. Inferior furs, remodeled, may be sold under the names of furs much superior in wearing quality, or in warmth, or in both; as, for example, when remodeled, rabbit (a fur notably poor in wearing quality) is sold as ermine, or remodeled muskrat as seal! Such remodeled furs may often be sold at ten times their legitimate value, warmth and durability considered! The pelts of animals from warmer latitudes, such as the opossum, woodchuck (marmot), raccoon, and certain species of monkeys, are worked up by skilful dressers into products very different from their originals. The names which are given to such remodeled furs are the names of animals of colder latitudes, such as otter, seal, sable, etc., animals which possess furs superior to those of the creatures of warmer zones in respect to denseness and softness of the under or fur hair, and to fullness and length of the over or protective hair. Furthermore, the dyeing and processing to which the warmer latitude furs are subjected render the hair less durable because more brittle. It is clear that there exists a need for some definite criterion by means of which furs, no matter how altered by the dyer and remodeler, can be indubitably identified as to species source. This need the microscopic study of the hair shafts of mammals will help to meet.

cuticular scales of hairs develop in such a way that they are directed away from the skin suggests that they may afford protection against the intrusion between the hairs —and so on to the skin itself—of foreign bodies, of parasites, and water. Furthermore, any such extraneous substances which may have gained entrance would tend to be worked outward away from the skin to the outer surface of the hair covering, by the motions into which the hair is thrown by the muscles of the body.

The technique of microscopical examination of hairs demands, primarily, an ability to manipulate the microscope and the source of the illumination of the object on the stage. Various arrangements of the microscope and microscope lamp secure different types (see page 435) of illumination, in order to bring into visibility the various structural parts of the hair (89, 90, 91, and 92 on this page). Photomicrography gives earnest of becoming a valuable aid in the study, not only of the cuticular scales or medullas, but more especially of the pigment granules—their shape, color depth, and patterns of arrangement.

Professor Henry E. Crampton, of Columbia University and the American Museum of Natural History, has led a series of expeditions to the islands of Polynesia for the study of zoögeography and evolution

Research in the South Seas

With editorial introduction and a review of a recent study on the land snails of Tahiti [1]

EVER since Darwin put forward the theory of Natural Selection as an explanation of the way evolution works, scientists everywhere have been weighing it in the balance and searching for a more fully satisfactory explanation. It is recognized that the survival of the fittest according to a selection by nature from among the variable members of a race is surely not the whole, in fact, must be but a small part of the story of the cause of evolution and its method of procedure.

Thus today whether the aim of a man's research work purports to be morphological, embryological, cytological, physiological, zoögeographical, or taxonomic, quite certainly the investigator himself has one main hope. He desires to discover evidence along contested evolution problems: whether in any given group of animals or plants evolution works equally and at random in very many different directions, or along a few definite lines only; whether new species are built up slowly from accumulated small variations, or come into existence by leaps—by mutation, as sports; whether evolution is a force ploughing its way in the given group to a definite end in accordance with chemical and physical law and from internal urging, or, if evolution is effected by such a growth force, whether the direction taken by it be controlled by the environment. There are, suffice it to say, various schools of belief among scientists today.

An intensive work of investigation by Professor Henry E. Crampton, of Columbia University and the American Museum of Natural History, on the land snails of Tahiti in the

[1] *Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species Inhabiting Tahiti.* By Henry Edward Crampton. 313 pp., 34 plates, 252 tables, 7 text figures. Publication No. 228 of the Carnegie Institution of Washington, January, 1917.

By courtesy of the Carnegie Institution

View of Taiarapu, the smaller, lower part of Tahiti Island. The islands of Polynesia, resulting from a subsidence of the land, are the tops of mountain ranges, volcanic masses with great radiating systems of contiguous valleys

South Seas, is of particular interest, in part because of the unique opportunity for a study of evolution given by these numerous sharply marked-off island species, but primarily because of his conclusion after many years' study of the data that, although each group of islands has its own group of species, each island its own species different from all others, and even in many cases each of the radiating valleys of each island its form peculiar to it, these have not been evolved in any degree by the influence of the environment. We quote him in the matter:[1] "In a word, the rôle of the environment is to set the limits to the habitable areas or to bring about the elimination of individuals whose qualities are otherwise determined—that is, by congenital factors."

Professor Crampton had long been conducting experimental studies in variation and selection on the saturnid moths. As a check to that work, which necessarily was carried on under the artificial conditions of the lab-

[1] "Résumé," p. 311.

By courtesy of the Carnegie Institution

Looking into three valleys on the southern side of Tahiti.—The high temperature, large amount of moisture, and low barometer make the many valleys of Tahiti ideal habitats for snails. Each valley may have its form peculiar to it. The tops of the ridges are dry and barren and the snails do not cross from valley to valley oratory, he inaugurated this parallel study on snails under natural environmental conditions. On four of several expeditions made to Polynesia he has reported in a volume brought out by the Carnegie Institution, under the auspices of which three of the four expeditions were made (1907–8–9). The field survey has been exhaustive in Tahiti of the Society Islands, building on the former researches of Professor Alfred G. Mayor,[1] director of the department of marine biology, Carnegie Institution, Washington, and has also been extended into various of the Cook, Tonga, Samoan, Fiji, and New Zealand islands.

As Professor Crampton points out, the snails of the genus *Partula* are a most fortunate biological group in which to study evolution—compared, for instance, with any continental group where there are not geographical barriers sharply marking off the species. In the case of *Partula* the area of its distribution is comparable in size with the United States, but it is made up of ocean waters with habitable islands (the tops of mountains after subsidence) acting as isolated centers of evolution.

In the work in Polynesia Professor Crampton collected about 80,000 snails from two hundred of the valleys in the Society Islands. Visitors to the American Museum will be interested in the topographical model of Tahiti, exhibited in the Darwin hall. Shells from the various valleys are suspended above the model in their respective places, presenting graphically a suggestive story of distribution in the south Pacific.

We bring the memoir on *Partula* to the attention of readers of NATURAL HISTORY in the following review[2] by Professor Mayor, of the Carnegie Institution:

The present volume deals with snails from Tahiti alone, and the thorough, scholarly, and conservative treatment given the subject renders this work of paramount value to all future students of the variations of *Partula*.

Not alone were variations and distribution of the adult snails studied, but the young contained in the brood pouches of the adults were dissected out, thus throwing light upon the fecundity of each variety and the ratio of elimination of the young before they can reach maturity.

Crampton shows that these snails are not found in the dry lowlands along the shore, nor do they occur in the cold regions of the high peaks of the interior, for a temperature of 55°–60° F. stops their activity. The snails are therefore restricted to the relatively moist deeply wooded troughs of the intermediate regions of the valleys, where they are commonly found during the daytime on the undersides of the leaves of the banana, wild plantain, caladium, turmeric, wild ginger, and dracæna.

The ridges between valleys are generally dry, and thus the snail population of each valley is more or less isolated. Crampton finds that these snails descend from the trees and bushes and feed during the night, or on moist days, upon decaying vegetation. The young and adolescent are more active in this feeding reaction than are the adults.

It has long been known from Garrett's studies[3] that the Tahitian species of *Partula* like the *Achatinella* of Oahu varied from valley to valley, some forms ranging over a wide area while others are restricted to a single valley, or even to a limited region within a valley.

In general, moreover, the farther apart two valleys the wider the diversity between their snails, although this is not always the case. Crampton's work has the merit of giving precision to our hitherto more or less vague knowledge of the distribution of the eight species of *Partula* found in Tahiti. He shows conclusively that great changes have occurred since Garrett studied the snails in 1861–84, and that in some cases the species have spread over wider areas and in the interval have produced some new subspecies or varieties. Thus the fascinating picture of a race in active process of evolution is presented. The details of this process are rendered clear by the excellent photographs of relief maps, and the numerous diagrams which accompany the text.

In a brief review such as the present it is not possible to do justice even to some of the more important details of Crampton's masterly work, but it is interesting to see that according to Garrett, *Partula clara* was rare and found only in a sector of valleys comprising about one fourth the area of Tahiti, while Crampton found it to be very common and to range over four fifths of the whole island, this dispersal having been accomplished by migration from the former restricted habitat of the species. There are now seven subspecies, and mutation has occurred not only in some of the new valleys the snail has occupied since Garrett's time but also in the area in which it was found by Garrett.

Partula nodosa, which in 1861 was confined to Punaruu Valley, has now migrated into six other valleys, and three new varieties have arisen in the area into which it has traveled.

[1] Mayer, A. G. "Some Species of Partula from Tahiti—A Study in Variation." *Memoirs Mus. Comp. Zool.*, Cambridge, Vol. XXVI, No. 2, 1902.

[2] By courtesy of *Science*, N. S., Vol. LI, No. 1310, February 6, 1920.

[3] Garrett, Andrew: "The Terrestrial Mollusca Inhabiting the Society Islands." *Journ. Acad. Nat. Sci.*, Philadelphia, Vol. IX, second series, part 1, 1884

Nearly one half of Crampton's volume is devoted to an analysis of the group species *Partula otaheitana* with its eight subspecies and varieties of primary, secondary, and tertiary degree, thus constituting the most complex of the known species of *Partula*.

In Fautaua Valley these snails form an extremely complex colony which stands in parental relation to the diverse colonies of other valleys; for in any one of the latter the shells exhibit one combination or another of the so-called unit characters displayed by the Fautaua group as a whole. In this snail Crampton finds some evidence that in the variety *rubescens* red and yellow colorations bear a Mendelian relation to each other, red being dominant. On the other hand, in the variety *affinis* plain color seems to be dominant over the banded pattern in Mendelian inheritance.

Partula hyalina is peculiar in not being confined to Tahiti, for it is found also in Mangaia and Moki, of the Cook Group, and Rurutu and Tubuai of the Austral Islands, and in marked contrast to this wide dispersal *Partula filosa* is found only in Pirai Valley, and *P. producta* in Faarahi Valley and neither one has migrated from these valleys since Garrett's time.

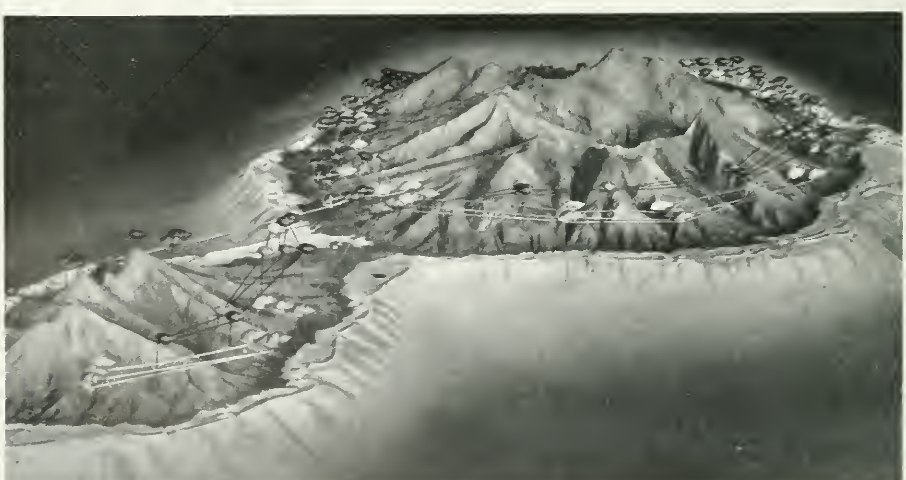
Crampton concludes that in the production of new varieties the originative influence of environment seems to be little or nothing, and isolation is a mere condition and not a factor in the differentiation of new forms. This is in accord with the studies of Bartsch[1] upon *Cerion*, for he found that no new varieties were produced in any of the numerous colonies of Bahama cerions which he established upon the Florida Keys from Ragged Keys near Miami to Tortugas. When, however, these cerions of Bahaman ancestry crossed with the native from Florida, the second generation of the hybrids gave rise to a large number of variations both in form and color.

This observation indicates that similar experiments should be conducted upon *Partula*, for it seems possible that new species may result from the breeding of mutations with the parent stock, or of species with species producing fertile hybrids unlike either of the parent stocks.

The editorial work on Crampton's volume reflects the greatest credit upon Mr. William Barnum, the well-known editor of all publications of the Carnegie Institution of Washington. The fifteen colored plates lithographed by Hoen are faithful reproductions of the colors and appearance of these snails, and the fact that the book is published upon the best of paper is fortunate, for it will be even more interesting to students a hundred years hence than it is at present.

Crampton's work is of such wide interest and importance, and in the light of Bartsch's observations, so suggestive of future experimental research, that it is hoped these studies may be pursued continuously under the auspices of the Carnegie Institution until final conclusions have been reached through breeding experiments conducted in the field. —ALFRED G. MAYOR, Director of the Department of Marine Biology, Carnegie Institution.

[1] "Experiments in the Breeding of Cerions." Vol. XIV, 1920. Papers from the Tortugas Laboratory, Dept. of Marine Biology of the Carnegie Institution of Washington.



An exhibit in the Darwin hall of the American Museum.—Model of Tahiti, the largest island of the Society group in the south Pacific. Tahiti has an area of 350 square miles and consists of two parts, each with the crater of an extinct volcano. It reaches 7500 feet elevation, and is one of the "high" islands of the South Seas in distinction from the low coral atolls. The high peaks of Tahiti are hidden by clouds through the day. The model is a suggestive lesson in geographical distribution and evolution: it is constructed after charts, photographs, and observations by the expedition; shells of the snails inhabiting the various valleys are suspended above in their respective places

Fishes of the Spanish Main

By JOHN T. NICHOLS
Associate Curator of Ichthyology, American Museum of Natural History

PERHAPS nowhere in the world is there a greater variety of marine fish life than between Florida and the coast of Brazil. The trade-wind current westward along the coast of South America, entering the Caribbean and Gulf to emerge northeastward as the Gulf Stream, binds this whole area together, and gives it a remarkably uniform fish fauna, when one considers the distances involved. It follows that there are certain strategic localities, where if one were to look long and diligently enough there would be a chance of meeting with almost every kind of fish of importance of the entire area. Scarcely a student of American marine fishes since the time of Cuvier but has taken new plunder in the form of previously unknown species from the old Spanish Main. Years ago the statement that those waters had been "gone over with a fine-toothed comb" would not have sounded unreasonable, but in spite of the numerous species already known and described, new ones are continually turning up.

My first studies of West Indian fishes were made sixteen or seventeen years ago at a zoölogical laboratory which Professor Mark, of Harvard University, had just established in Bermuda. There still remain clearly in my memory many species as I saw them there—the schools of snappers skirting the shore, the big-eyed red squirrel fishes, the lizard fishes lying on the sand under the clear water in wait to dart upon their prey, and the long green houndfish (*Tylosurus*) swimming close to the surface and driving schools of "fry" (*Stolephorus*) into the air. How dazzling the white limestone roads with their tamarisks! It was midsummer, and low sprawling cedars gave no protection against the sun, more trying for a northerner than it had been at sea on the equator or in better shaded localities within the tropics. As a result, when at the end of our stay, Mr. Owen Bryant and I undertook a memorable cruise of a few days in an open dory we had lost our ordinarily excellent appetite for rough food. What, if anything, else in the way of provisions we had brought, I do not remember, but there was a large tea box full of dry toast. The day was hot. To be off and on the water was pleasant, skirting the shore at a fair distance, no land in view to seaward, but protected against ocean swell by reefs and shallows. The wind was light and baffling, the helmsman careless, and a sudden puff hove the dory's lee rail under and filled the boat one third with sea water,—and behold! the tea box with our store of food floated an instant, then gradually tilted, filled, and settled.

On the islet where we made camp by hauling the dory ashore, by great good fortune a Portuguese boy appeared who knew where milk was to be obtained; otherwise we should probably have gone hungry. This boy was also much interested in our marine investigations and on the morning we set sail again to end our brief cruise, he told us of a strange yellow fish in a fish trap off the shore of the islet, which investigation proved to be one of the surgeon fishes. These are species with an ordinarily sheathed, antrorse knife-like spine on the side of the tail, with which they very successfully keep their finny rivals at a proper distance. Gray and blue surgeons we knew of, but not a yellow one. The form of this individual was sufficiently different to assure us it was no mere color freak. This, the first unknown fish it had ever been my good fortune to meet, thereupon started for its final destination, the Agassiz Museum in Cambridge, and was later described as *Teuthis helioides* by Dr. Thomas Barbour. Occasional individuals have since turned up at Bermuda, but I have always felt a sense of proprietorship for this beautiful species, and am correspondingly pleased to find the American Museum's first specimen in a Bermuda collection recently received.

The same collection contains another old friend, the ocean pipefish (*Siphostoma pelagicum*), abundant in floating gulf weed fifteen hundred sea miles to the eastward of Bermuda. This slender little pipefish[1] seems not to invade, or at least very little, exactly similar gulf weed farther west which is occupied by the mouse fish (*Pterophryne*); in fact, aside from Bermuda, the

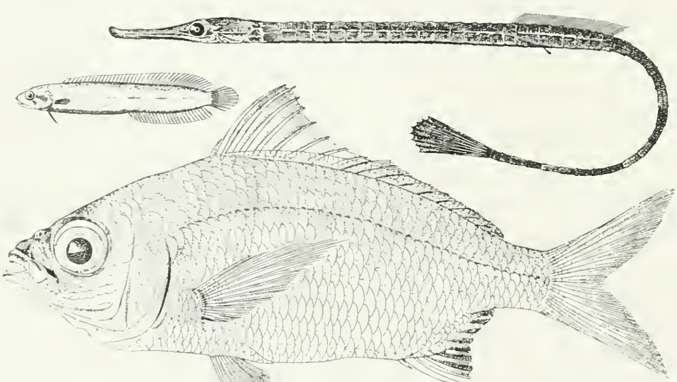
[1] Nichols, John T., 1910. A Note on *Siphostoma pelagicum* (Osbeck). *Bull. Amer. Mus. Nat. Hist.*, XXVIII, Art. 14, pp. 155–157.

species is not satisfactorily recorded from the West Indian region.

There is no better chance anywhere of learning the laws which govern the distribution of marine fishes than in this West Indian region. A proper study of the subject would be a creditable life work. During the last ten years the American Museum has built up a collection which will serve as a basis for such investigation when the man to undertake it arrives.

The New York Aquarium has always had a goodly representation of living West Indian fishes: active, changeable, brightly colored pomacentrids, wrasses, parrots, and angels of the reefs, elegant, free swimming snappers and grunts, larger groupers, evil-looking morays (the most degenerate of the shore eels), and many others. In earlier years these fishes of the New York Aquarium came almost entirely from Bermuda, more recently for the most part from Key West. By 1910 the American Museum had already acquired a fair series of such forms through the courtesy of the Aquarium, and in that year the writer spent five weeks as the Museum's representative, a guest of Messrs. Ernesto G. and Alessandro Fabbri, cruising among the Florida Keys. We were well fitted out with collecting equipment and devoted ourselves to obtaining as many as possible of the species of fishes there present, for the Museum's reference collections. In spite of the short time available, the work was so thoroughly successful that it has not since seemed necessary to make a point of acquiring further large general collections of fishes from the West Indian fauna.

Incidental to gathering and caring for this material, considerable knowledge was gained of the many species of fishes making up the complex of this fauna, and attention was first called to the innumerable interesting problems involved in their relationships and distribution. Since then each of several hasty trips south into the realm of warm blue water, sunny skies, and drifting sargassum, has opened wider vistas for research on such problems. More particularly were the problems comprehended during a month spent at Porto Rico in the summer of 1914, incident to the survey of the island by the New York Academy of Sciences. Each trip also has yielded discovery of valuable new species.



Some new fishes from the Spanish Main.—A few of the species collected for the first time, and described in the *Bulletin* of the American Museum of Natural History between 1910 and 1920. From top to bottom they are *Doryrhamphus sierra* (Porto Rico), *Stathmonotus tekla* (Florida), *Xystaema havana* (Cuba, Florida, Brazil, Porto Rico, Turks Islands), *Gobiesox yuma* (Florida), *Gymnachirus melas*, and *Scorpaena colesi* (both North Carolina)

On February 24, 1910, the Fabbri expedition secured a little blenny only 19 mm. in length, from a few inches of water on rocky shallows at Sand Key, off Key West Harbor, the second species, and it may be added the second individual also, of the genus *Stathmonotus* ever collected, the first having come from the same vicinity. Blennies may be divided into two groups, the one northern, subarctic, the other tropical. The strange thing about *Stathmonotus* is that though clearly referable to the first group, it comes from waters occupied by the second. Does this mean that when the last nooks and corners of the Spanish Main have been investigated, we shall have representatives of every known type of marine fish, with the probable exception of those characteristic of the Antarctic and north temperate Pacific?

During a short stay in Cuba in 1912, considerable useful material was obtained in the fish markets, where a varying array of beautiful and interesting fishes is displayed each day. Desirous of "wetting a line" myself, for which there had been little opportunity, I went fishing one evening from a little pier on a sandy beach near Havana, and almost immediately caught a large-eyed silvery fish about six inches long, one of the mojarras. It resembled several closely related species with which I was familiar, more particularly, however, one from the Pacific, of which there were questionable records from the West Indies. More careful examination showed it to belong, really, to a different genus from any of these and a species as yet undescribed, the genus otherwise represented in our fauna by a single, different, unvarying form. It has been most interesting to have this new mojarra since turn up from Florida, Brazil, Porto Rico, and Turks Islands in the Bahamas, showing that it has a wide distribution and is not uncommon, and to speculate on the interesting questions raised as to relationships and evolutionary differentiation within the mojarras.

Among the shore fishes obtained at Porto Rico in 1914, two were described as new; and two other rather striking forms, a small filefish and an orange-yellow *Eupomacentrus* (one of the small gaudy fishes which dart in and out among the intricacies of rock or coral), proved a disappointment as both had been collected a few years before at Bermuda. The likeness of their species may be but coincidence, or the result of similar careful study, rather than wholesale collecting. Backed by other evidence, however, it seems rather to indicate an intimate relation between the fishes of the two islands. When the extent of this relation has been worked out, and determination has been made whether it be caused by comparative propinquity or some environmental similarity, we shall have an interesting sidelight on more general problems.

The northern limit of the West Indian fish fauna on our shores may be drawn rather sharply at the capes of the Carolinas. Recent studies made there over several consecutive summers by Dr. Russell J. Coles[1] in coöperation with the fish department of this museum, have turned up some extremely interesting fishes, thrown light on their habits and seasonal migrations, and demonstrated that the bight of Cape Lookout, North Carolina, is a veritable fish trap to catch wanderers from the South. The West Indian influence is felt considerably farther north along the coast, and a number of typically southern species occur among those known from within fifty miles of New York City, where they are most commonly met with in autumn. The latest addition to our recorded local list of fishes, No. 248 (to be exact) is of this sort. It is a cowfish, a small-mouthed, sluggish species, encased in a bony triangular shell, with hornlike spine over each eye, and was captured near Fire Island Inlet about November 1, 1919.

The Spanish Main is today a rich field for investigation. If a naturalist who sails its blue waters have knowledge of the common fishes sufficient to pick out at once an unusual one among them, whether it be darting into view for an instant below the clear water of the reef or lying on the slabs of some island fish market; if he have understanding of the varied habits and habitats of the different species sufficient to recognize, for instance, some peculiar bit of shore or reef as introducing unusual environmental factors; if again he have time and opportunity to follow the schools of young fishes which live under the drifting, highly-colored, bubble-like, Portuguese man-of-war or about the sprays of gulf weed far out along the periphery of the Sargasso Sea, or to visit particular isolated islets or ledges where the fishes (to judge from the position on the chart) may furnish evidence for or against a hypothesis in mind especially if he have alertness always to look out for and to seize stray bits of information drifting within reach, he could scarcely find cruising grounds in the world richer in scientific possibility.

[1] Of Danville, Virginia, author of various scientific papers on sharks and rays. Mr. Coles is the man who took the late Theodore Roosevelt out into the waters of the Gulf of Mexico and taught him the dangerous sport of devilfish hunting. See AMERICAN MUSEUM JOURNAL, Vol. XVI, April, 1916, pp. 217-27.

ROBERT W. DE FOREST

President of the Metropolitan Museum of Art, New York City, since 1913, formerly secretary (under the presidency of the late J. Pierpont Morgan, 1904–13). Mr. Henry W. Kent is the present secretary, acting with President de Forest

Men of influence and broad vision in New York City, interested in the fine arts not only as such but also from the human standpoint and believing that for all people beauty and refinement are better than the dreary or the squalid,—these men of the past fifty years and again of today have joined with the common people in giving our city the great Metropolitan Museum of Art at Eighty-second Street on Fifth Avenue. It is a partnership between private and civic ownership. Every taxpayer may take his family to it with pride, for he helps to support it every year; the man of great wealth may look upon it with what must be an immeasurable satisfaction, for by means of it he has brought relaxation and joy to a multitude of people.

Mr. de Forest was first actively connected with the museum in 1889, but his memory carries well back along the whole story of the institution's development, through association as a boy with his father-in-law, the first president, John Taylor Johnston

The Golden Jubilee of the Metropolitan Museum of Art, 1870-1920

WITH A PROPHECY OF THE PEOPLE'S MUSEUM OF THE IMMEDIATE FUTURE

"The diffusion of a knowledge of art in its highest forms of beauty will tend directly to humanize, to educate, and refine a practical and laborious people . . . also to show to students and artisans of every branch of industry what the past has accomplished for them to imitate and excel."
—*Words of Joseph H. Choate at the dedication of the Metropolitan Museum of Art, in 1880.*

NEW YORK CITY has two great museums which stand especially representative of the spirit of America. The Metropolitan Museum of Art is a treasure house of the truth and beauty that has been wrought by the hands of men, past and present,—according to the original words of its charter, a museum "to encourage and develop the study of the fine arts and the application of arts to manufactures and practical life." The American Museum of Natural History treasures and displays *natural* beauty and the truth of the earth and of created life as man finds it on the earth, and it also coöperates with manufactures and practical living.

Covering quite different fields, the two museums have nevertheless always been closely allied, primarily in that they exist freely for all people, and in that education is their chief purpose. Both institutions give without price not only of their accumulated beauty and knowledge, but also of the interest and time of their officials, to whoever asks, be his need or purpose what it may. The two institutions have developed side by side also in their methods of educational work, with lectures and instructors at the centrally located buildings and extension work in the form of loan collections to the city schools and libraries. Also they have traveled the same road in their coöperative and partnership relation with the state and city governments, so that in their buildings and maintenance they are truly the people's museums, public in the sense of ownership by all.

Likewise the two organizations trace their origin from very humble beginnings and pioneer effort of a group of public-spirited men—in some instances the same men for the two museums. As we view the institutions today, splendidly housed, with vastness of rich possessions, and national, even international, prestige and influence, it is not easy to realize that their beginning was humble, or if so that it was not in a very remote past. They have the development of mature institutions. Some of the European museums with which these American museums must be compared are several centuries old. Our American civilization as marked by free

The headpiece portrays a sculptor's model in limestone of a ram's head, Ptolemaic period, a recent gift to the museum and an interesting item of the Fiftieth Anniversary Exhibition.

institutions is about 300 years old. That only fifty years of this time has gone into the building up of New York's leading museums tells a story of astonishing growth.

The American Museum of Natural History, founded in 1869, passed its fiftieth anniversary in 1919, deferring a celebration until 1924.[1] The Metropolitan Museum of Art, inaugurated in 1870, reached its semicentennial one year later than the American Museum and has celebrated its Jubilee during the summer just past.

This celebration has been an auspicious occasion, setting off 1920 as a year memorable in the museum's history. For such have been the strides made by the New York art museum, especially during the period since the beginning of J. Pierpont Morgan's presidency[2] (1904–1913), that it stands today the leading art museum in America and even approaches a position as compeer of the greatest museums of the world.

The fiftieth anniversary celebration opened on May 7. On May 18 was the formal unveiling at the foot of the grand staircase in the Fifth Avenue hall[3] of two marble tablets bearing inscribed the names of the founders and benefactors of the museum. The addresses[4] of the occasion were delivered by representatives of the state and city, John H. Finley and Francis D. Gallatin, and by Elihu Root, of the trustees; also by three presidents of art museums, namely, Morris Gray, of the Museum of Fine Arts, Boston, Charles L. Hutchinson, of the Art Institute, Chicago, and Robert W. de Forest, for the home museum, New York.

One feature of the celebration, perhaps of greatest human interest, has been the room of the Memorabilia where hang portraits of the men who have stood back of the museum through the fifty years. No project prospers as has the Metropolitan Museum of Art, even when it has that greatest stimulus, the opportunity which a growing metropolis gives, without hard work on the part of its supporters and a steady holding fast to the ideal in view. We read in the faces that speak from the walls of this gallery the hopes and faith, and always the generosity of the man of imagination. They all live as we pass them in review, even those who do not walk the haunts of men today, for their work embodies the spirit of democratic America and connects inseparably the living future of the museum with its past.

The father of Theodore Roosevelt is there: John Taylor Johnston, man of affairs, was the first president; among the lawyers is Joseph H. Choate; among the business men, of course preëminently J. Pierpont Morgan, but also many others, especially of the present generation; among the literary men are William Cullen Bryant and George William Curtis; the artists constitute a long list. A vital fact, however, relative to the organization and after support of the Metropolitan Museum (as also of the American Museum), is that it stands for the interests of many classes, not of the artists alone, or of any other class predominantly, and the money of a large group of men, not of one or two only. The founders included the foremost literary, artistic, educational, and business interests of the time. That William Cullen Bryant, president of the Century Association, poet, journalist, art counselor, and publicist, gave the address at the initial meeting for the founding of the museum indicates the breadth of idea on which the institution rests.

The great human appeal of the Memorabilia carries our interest into a semicentennial pamphlet just published by the museum, "A Review of Fifty Years' Development." Although in statistical and catalogue form, it is not dry reading, and we quickly glean from it a story of growth according to what seems geometrical progression. The first gift was a Roman sarcophagus in 1870, the first purchase 174 paintings[5] in 1871. By 1875 the collections had reached proportions to have a first guide book printed. In 1886 was separated off from the general administra-

[1] Primarily because of conditions due to the war. Also with the hope that in the intervening five years the southern half of the museum building as planned and accepted for the city fifty years ago might then be completed and afford additional cause for the celebration of a golden jubilee.

[2] And therefore throughout the connection with the museum of the present president, Robert W. de Forest, who was secretary when Mr. Morgan was president.

[3] The decorations of the Fifth Avenue hall of the museum were designed for the occasion and carried out by Messrs. McKim, Mead, and White, Architects, of New York City, who gave their services in honor of the Jubilee.

[4] These addresses have appeared in the *Bulletin of the Metropolitan Museum of Art* during the summer months, 1920.

[5] These were bought without authority of the corporation and paid for with money borrowed for the purpose by one of the founders. During the present semicentennial exhibition, it has been observed that many paintings scattered through the various galleries were marked as belonging to this purchase of a half century ago.

tion a department of paintings, classical art was segregated in 1905, then Egyptian art, decorative arts in 1907, arms and armor in 1912, the Far Eastern arts followed, and the department of prints came into being in 1917.

The first bequest of money was in 1883. From 1886 on important bequests occur in close succession and increasing amounts; nearly twenty, about a fourth of them reaching or exceeding a million dollars. Most of these noteworthy bequests have come from New York, but the wide appeal of the institution is indicated, as called to the attention of the semicentennial gathering by President de Forest, in that the largest of all money bequests came from another state, and one other of more than a million came also from without the state.

Munificent gifts of art objects poured in to fill the continually increasing number of new additions to the building—the second addition in 1894, the fifth in 1910, the seventh in 1912, the eighth in 1917—until the building today, although still far from being complete, occupies a distance of four blocks along Fifth Avenue. The items of altruistic development especially shine out in the list of statistics: in 1891 the museum first opened its doors on Sundays; in 1907 was the first lending of lantern slides for the children of the city; 1917 saw the first manufacturers' exhibition in coöperation with the textile industries; 1918 the inauguration of free concerts. In other words, here is depicted the development of a storehouse of the beauty gathered by human thought and handicraft, and its continually growing use for the happiness and need of the dweller, permanent or transient, in New York City.

Since the formal opening, the celebration has taken the shape of special semicentennial exhibits, which more than 430,000 persons have visited in the six months between the opening in May and the closing November 1. So comprehensive has been this greatest exhibition of fine arts ever held in New York City that we have not space even to mention in general terms the main features or the chief loans. Fortunately, the shipments of Egyptian art, the first since the years of the war, arrived in time to form special attractions in that department. Also in the classical department various purchases made in Europe during the war were here in time to be exhibited.

The art collectors of New York City honored the museum as never before. More than one hundred allowed the most valuable works of art[1] from their homes and private galleries to come temporarily under the museum's care. These were installed alongside the permanent possessions of the institution in their proper places relative to period of art and department. Lovers of rare canvases, for instance, have had during the summer an enviable opportunity to study more than fourscore paintings from private collections representing periods from the thirteenth to the twentieth century.

Words of felicitation have been sent by the president and trustees of the American Museum of Natural History to the Metropolitan Museum of Art in recognition of the eminence it has attained. Earnest felicitations are extended by all its patrons and by all art and science museums of the country. But especially are tendered it the most profound respect and the warmest friendliness for its record in education,—for its effort to bring the history, biography, and beauty in its stores to the city's children, to workers in the industries, to the multitude who need to have knowledge of the part the fine arts can play in the leisure hours of life.

In the congested cities of this twentieth century social development has taken on an accelerated speed. Many questions regarding man's interests and behavior which had only moderate importance a half century ago now take on large significance. How the race shall spend its leisure is one of these: there arises a tendency to a new delimitation of human character when for the greater part of a crowded and mixed population the amount of leisure in each twenty-four hours and each seven days increases at leaps and bounds—accompanied by proportionately enlarged incomes to be used in this leisure. We can but wonder what direction the released and accelerated mental and spiritual powers will take. Always the question is, how large a proportion of the race in its instinctive reaching for knowledge and happiness will find something better than mere

[1] A complete list of the loans to the various departments is given in the *Bulletin of the Metropolitan Museum of Art*, May, pp. 112–19, June, pp. 144–45. 1920.

pleasure and the physical comforts of existence; and the responsibility for the answer to this question lies largely today at the doors of the country's public educational institutions.

If we look over our public sources of education and culture in America which aim to maintain active daily influence through a large part of the year, the museum, more than any other, perhaps, seems to be on the right road to fill the need; it can give pleasurable enlightenment along the lines of art and science in and for themselves and in relation to industry and the home. The combination of civic and private organization and control is particularly in the museum's favor.

The close observer would suggest one step the Metropolitan Museum of Art, the American Museum of Natural History, and all large museums of large cities should take at as early a date as practicable in face of difficulties of operation and finance. They should open their doors at night and advertise the fact largely. With enormous stores of latent energy why keep behind the ideal of accomplishment? Why keep behind the times, while other influences like the moving-picture theaters are developing a social power detrimental to refinement and culture which will be difficult to counteract? If there has been no "demand," that but urges the speedier action when the need is evident. The great mass of the people work by day. They have no opportunity to visit an institution that closes at five in the afternoon, whereas everyone seeks relaxation and entertainment in the glamor of the evening hours.

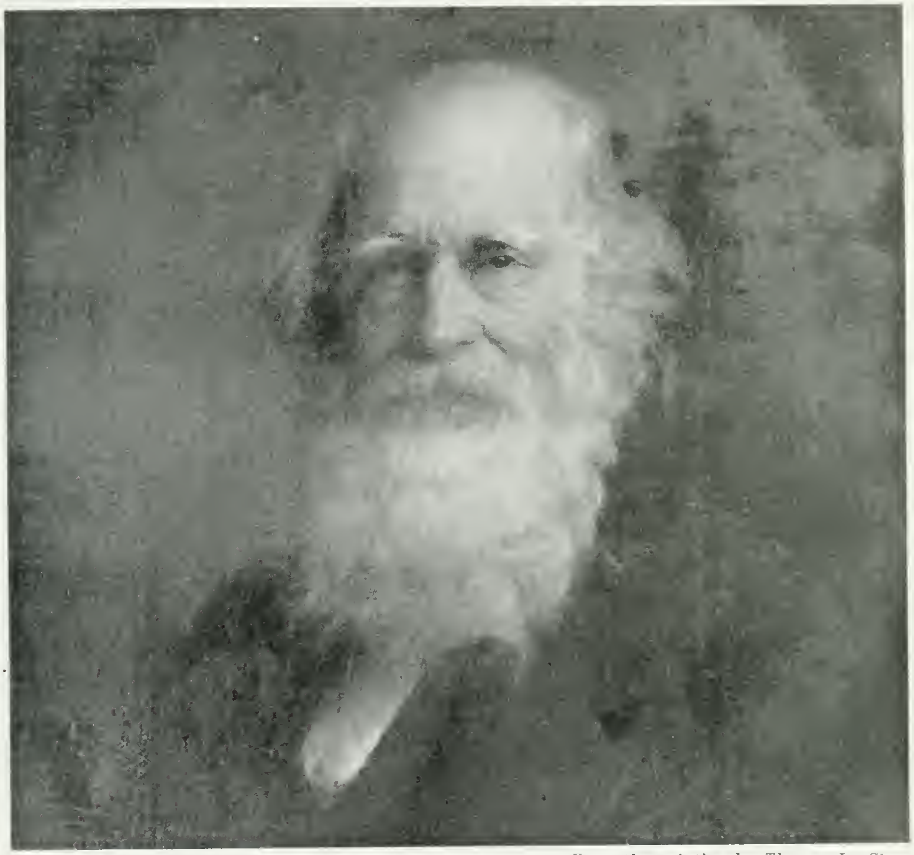
Our two great museums are so organized and conducted that they are adapted inherently to take a strong hold on the imagination and affections of the people and to become a cultural force of first magnitude. There is relatively little change necessary to increase a hundred-fold a usefulness already so great—except that each institution, as the years allow, will, possibly, incorporate the modern practical side of its work under the one roof, instead of merely coöperating with organizations of applied art and science, as at present.

Among the immediate needs, then, in addition to night opening, are an increased staff of instructors in the exhibition halls, a larger number of popular lectures, and a larger number of motion pictures. Orchestral music also will probably soon take a considerable place in museum development—it has already been inaugurated for stated intervals in the Metropolitan Museum of Art. It will be one of the strongest of compelling invitations to thousands upon thousands of people when the time comes that it is installed a regular feature, a background of sound, dispelling formality and invigorating thought and conversation among the crowds who stand or wander at pleasure in the great lighted galleries of exhibits. We quote from President de Forest's semicentennial address in this matter: "What can make more for Americanism in its true sense, for good citizenship and neighborliness than our free concerts, the latest of which was attended by more than ten thousand people . . . great crowds from the east side, west side, and every side—men, women, and children—who are filled with rapture when music combines with its sister arts. . . ."

As to motion pictures in the museum, it may well be argued that their first place is in art and science, releasing in large part the field of dramatic action and portrayal of human character and passion to the greater dignity of the true theater. This refers to art and science in the broadest sense, covering the fine arts, with practical art in all its branches (industrial and decorative), realistic living nature on land and sea, expeditions and travel of every character for art or science, pure science, applied science in all its branches (hygiene, modern manufactures, inventions, etc., etc.), and especially a convergence of the fields of art and science in a study of man and of the highest mental accomplishments and ethical conduct of man.

The outlook thus over the combined fields of art and science is vast. Moreover, because of the very relation with man's activity and the advance of civilization these fields are daily widening their borders. To say that they carry intense human interest to all classes is but reasoning in a circle.

In these fields and using the tools for educational work already named the great museums of the immediate years to come are undoubtedly destined to reach a goal of supreme usefulness—"tending directly to humanize, educate, and refine a practical and laborious people" as represented in the democracy of America.—THE EDITOR.

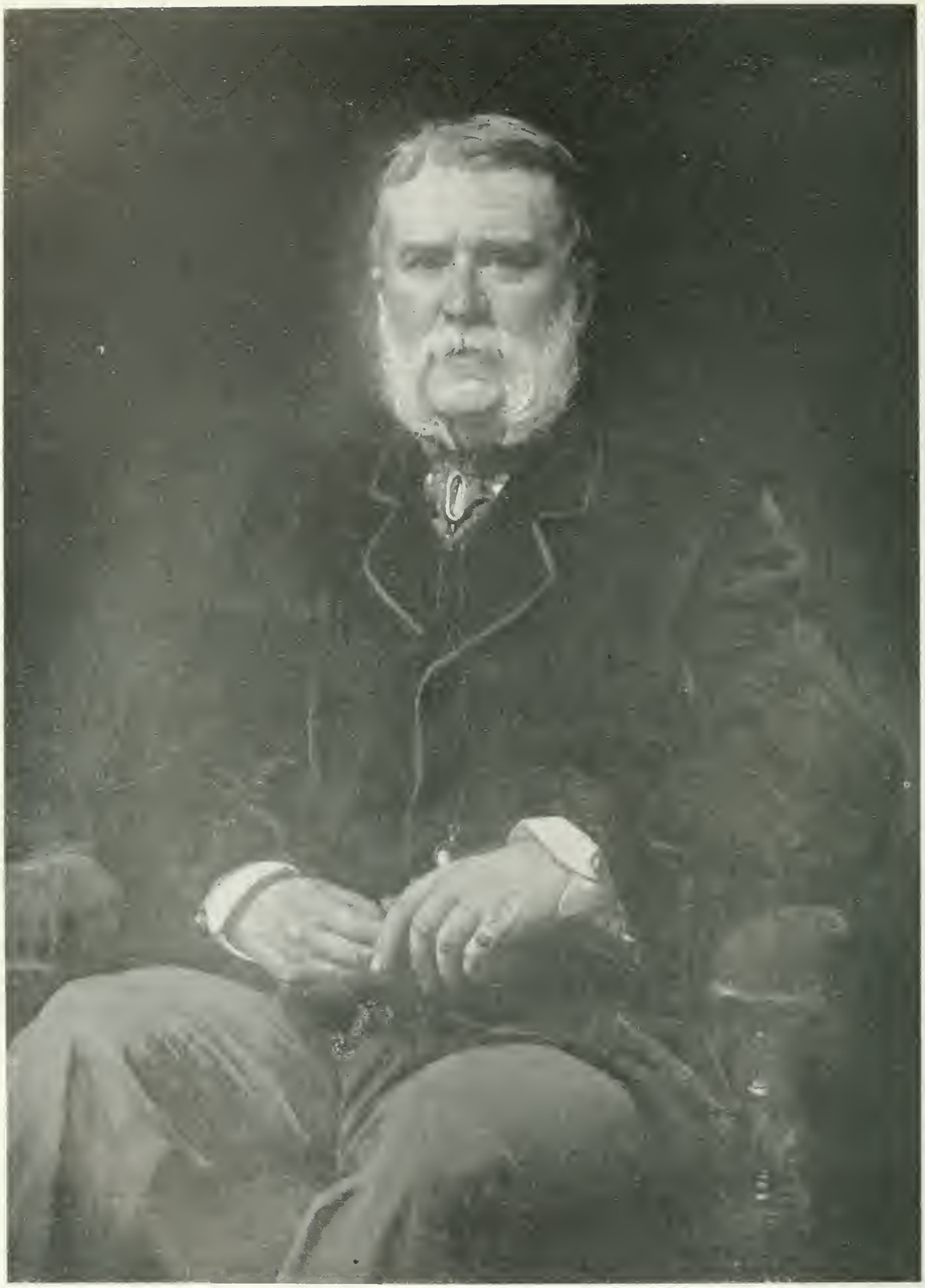


From the painting by Thomas Le Clear

THE AUTHOR OF THANATOPSIS, 1794-1878

William Cullen Bryant, American poet, art counselor, publicist, and journalist (editor of the New York *Evening Post* for nearly fifty years), was chairman at the great meeting for the founding of the Metropolitan Museum of Art, at the Union League Club, Twenty-sixth Street, November, 1869. His address has been much quoted. The following extract was prophetic:

"The growth of our city is already wonderfully rapid [this, fifty years ago]; it is every day spreading itself into the surrounding region, and overwhelming it like an inundation. Now that our great railway has been laid from the Atlantic to the Pacific, eastern Asia and western Europe will shake hands over our republic. . . . Here will be an aggregation of human life, a concentration of all that ennobles and all that degrades humanity. . . . We must be beforehand with vice in our arrangements for all that gives grace and cheerfulness to society . . . to the cultivation of the sense of beauty —in other words, the perception of order, symmetry, proportion of parts, which is of near kindred to the moral sentiments. . . ." *Portrait from the Memorabilia of the Metropolitan Museum of Art*

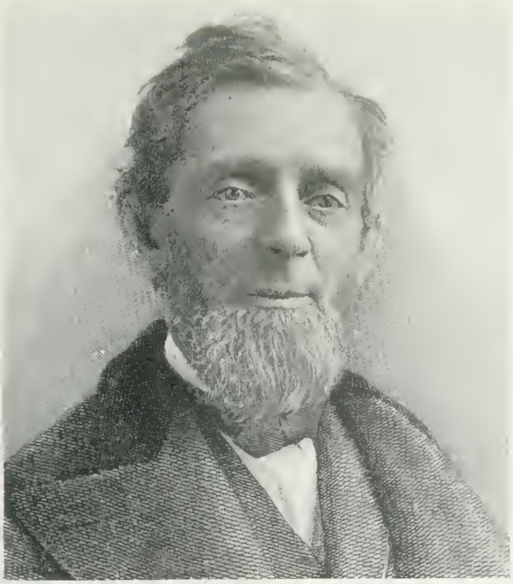


From the painting by Léon Joseph Florentin Bonnat

A MAN OF ENERGY, WILL, AND ENTHUSIASM

All honor is given today to the name of John Taylor Johnston, who was appointed president of the Metropolitan Museum of Art at the time of its founding and continued in this capacity throughout the formative period of the institution until 1889. After this he served as "honorary president for life." He owned the most important private collection of paintings in New York City in 1870, which he had opened freely to the people.

He was followed in the president's chair in 1889 by the art collector and banker, a generous friend of the museum for thirty years, Henry G. Marquand. The succession following has been Frederick W. Rhinelander, 1902, J. Pierpont Morgan, 1904, and Robert W. de Forest, 1913. *Portrait from the Memorabilia of the Metropolitan Museum*



George P. Putnam (at the left), 1814–72, represented publishing interests among the men who guided the early years of the Metropolitan Museum. He spoke at the first meeting (1869), was on the original subcommittee of thirteen to draw up plans of organization, and was a member of the first executive committee.

George William Curtis, 1824–92, with a high reputation as author, editor, and lecturer, known generally as a man who used his powers in support of Lincoln, represented with Bryant literary men of note among the museum's early adherents. *Portraits from the Memorabilia of the Metropolitan Museum of Art*

Tapestry, "September—The Stag Hunt," French decorative art of the eighteenth century, loaned for the semicentennial exhibition. This is one of twelve tapestries, woven at the Gobelins, from seasonal designs of about 1530

JOSEPH H. CHOATE, 1832-1917

As lawyer and statesman he was an enthusiastic advocate of the underlying educational idea of the Metropolitan Museum, that art is "the vital and practical interest of the working millions,"—thus when the question first arose relative to Sunday opening (inaugurated in 1891), he urged the need of the people. His high legal knowledge served the institution during all the years of his connection, from the founding in 1870 to his death in 1917—as it did also the American Museum of Natural History. It was he who in 1878 drafted the lease for the Metropolitan Museum by which the city became sole owner of the buildings with responsibility for their repair, the museum owner of the collections with sole right to the use of the buildings—a partnership the agreements of which have not been substantially changed since.

The Metropolitan Museum has just closed its Fiftieth Anniversary Celebration. There have been special exhibitions and ceremonies commemorating the work of men like Mr. Choate. But far surpassing any special celebration is the museum itself as it stands, open and active every day, with all its departments and avenues of work in full progress—notwithstanding the handicaps all public institutions have shared alike in recent years because of difficult financial conditions due to the World War. It is the free character of these institutions, developed in the same cause and spirit as the American Republic, that makes them capable of close entrance into the life of American citizenship

Portrait of Mr. Choate from the Memorabilia of the Metropolitan Museum of Art

Early eighteenth century wood sculpture in the Metropolitan Museum—coat of arms on English limewood

Tapestry, "Immortality," Flemish, about 1500. A loan to the Fiftieth Anniversary Exhibition of the Metropolitan Museum of Art in the summer of 1920

Eastman Johnson (at the left), 1824–1906, portrait painter and delineator of common life in *genre* canvases, was one of the founders and incorporators of the Metropolitan Museum of Art.

Richard Morris Hunt, 1829–95, architect of great distinction, also was among the original incorporators. He was a member of the first executive committee and acted as a trustee from the founding in 1870 until the time of his death. The fountain on Fifth Avenue between Seventieth and Seventy-first streets, executed by Daniel Chester French, was erected to Mr. Hunt's memory in 1898 by the Municipal Art Society of which he was president, the American Institute of Architects, Architectural League, National Sculpture Society, and Century Association. *Portraits from the Memorabilia of the Metropolitan Museum of Art*

Mr. Morgan became president in 1904 with Robert W. de Forest, secretary, and Edward Robinson, assistant director. A new period in the museum's history was soon indicated by successive steps of advance—establishment of new classes of membership, creation of the department of classical art, organization of educational work with the public schools, and of the expedition to Egypt. A new policy gave New York great loan exhibitions such as the works of Augustus Saint-Gaudens (1908), Hudson-Fulton Exhibition (1909), and Whistler Exhibition (1910), and gave student artists great freedom in time and privilege for copying paintings and sculptures. The Pierpont Morgan Wing, opened in 1918, contains the many collections he gave

J. PIERPONT MORGAN, 1837-1913

Mr. Andrews, distinguished bibliophile, was closely connected with the Metropolitan Museum from 1878 until his death in 1920. His great knowledge and love of books turned his interest to the building up of the institution's art library. He was librarian for many years and later honorary librarian. His annual report in 1881 just after the museum moved into the Central Park building listed 447 books and pamphlets in the library. Today this library covers the literature of architecture, sculpture, painting, etc., so extensively that it serves a large usefulness to many tens of thousand readers annually. *Portraits of Mr. Morgan and Mr. Andrews from the Memorabilia of the Metropolitan Museum of Art*

WILLIAM LORING ANDREWS, 1837-1920

CARVED WALNUT WOOD, FRENCH, EARLY EIGHTEENTH CENTURY

The collections of the Metropolitan Museum of Art are very rich in carvings in relief and in the round on various kinds of wood and representative of the art of many countries (see oak carving, French, pp. 457 and 464)

EDWARD ROBINSON

Director of the Metropolitan Museum of Art, New York City

Mr. Robinson became assistant director in 1905, and, on the withdrawal of Sir Caspar Purdon Clarke from the directorship in 1910, accepted the higher position. He had become connected with the museum in 1891 while director of the Museum of Fine Arts, Boston, taking charge of the work of collecting a complete series of casts. historically arranged, for the department of classical art.

Mr. Robinson's ideal for the Metropolitan Museum he states as educational efficiency, and the work of each department is formulated to meet this ideal. The collections are being built up on a scientific plan and exhibit the masterpieces of different countries and times, not only so as to be attractive and accessible for student artists and visitors, but also in such relation as to teach the history of art.

The museum points to the Egyptian galleries as an example of its recent growth and method. From relatively few unrelated objects exhibited in a single corridor, the Egyptian collections have developed until they present a historical sequence through fourteen galleries, covering from 4000 B.C. to 700 A.D. The excavation work of the museum's expedition in Egypt has been continuously carried on even through the years of the war, to the great enrichment of America's stores of original Egyptian art.

The development of the department of arms and armor (1912–20) is also cited. Under efficient organization, with expertly selected purchases and loans of great value, with rich gifts such as the collection of William Henry Riggs, also with exhibits covering the problem of armor as developed during the world war, this gallery of the museum today offers an unparalleled opportunity for study of the various phases of this subject.

Educational efficiency within, coupled with coöperation in educational and industrial work without, is particularly the policy of all great American museums today. Many of these are relatively of the same age, about fifty years. The demand of the time which brought about the incorporation of the Metropolitan Museum of Art and the American Museum of Natural History, gave rise also, for example, to the Museum of Fine Arts, Boston, and the Art Institute, Chicago. Through official representatives to the Golden Jubilee of the Metropolitan Museum, 1920, these sister institutions sent messages of greeting and cordial good wishes

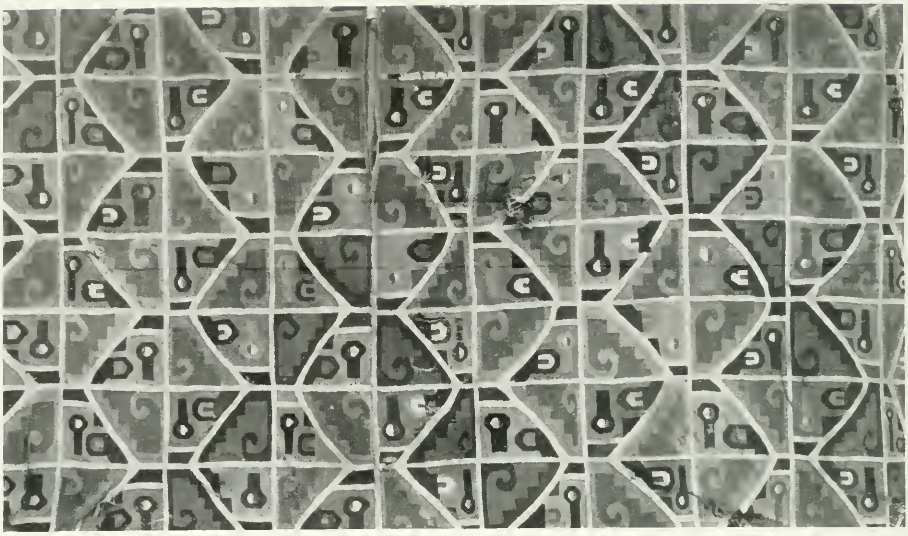
Chinese vase, Sung Dynasty, loaned for the Fiftieth Anniversary Exhibition. Hard, gray, porcelanous ware (Tz'ŭ-chou), covered with white slip and transparent glaze, the slip partly etched away to leave a large floral design

LOAN IN CLASSICAL ART

Head of a girl, Greek, fourth century B.C

That the Fiftieth Anniversary Exhibition of the Metropolitan Museum brought such richness of loans in Gothic, Renaissance, eighteenth century, and modern art, and but few in classical art, emphasizes that the art collections of America, contrasted with those of England, for instance, are not strong in the classical line—owing to the difficulty there has been in recent times to obtain Greek and Roman works of first quality. This marble head expresses the spirit of Praxiteles in Greek contemporary art, reflecting his style and carrying much of the delicate beauty of his work. The head was evidently part of a statue trimmed to its present shape in recent years

"And what should be the policies of the Metropolitan Museum in the future, so that our successors, when they come to celebrate its hundredth anniversary, may do so with the same satisfaction with which we celebrate its fiftieth? Strict adherence, in my judgment, to the policies of the past, with difference of emphasis, perhaps, and an open-minded readiness to meet changes in the public sentiment of the future."—*From address by President Robert W. de Forest*



Aside from the wonderful technique of Peruvian tapestry, the richness of its color is a marvel to the modern expert. Interment for a millennium in no way dims the colors, which are mostly from vegetable dyes, and, although intense, are never displeasing to the eye. The above design, which is typically Peruvian, consists of a repetition of the same geometrical motive arranged in different quarters of a series of truncated rhombs. The preservation of the cloth for such a great length of time is due to the fact that it was buried in the dry, nitrous sand of the Peruvian desert coast where rain seldom falls. This piece is from the collection of Sr. F. G. Estrada, recently purchased for the American Museum

A Prehistoric Poncho from Nazca, Peru

THE American Museum's series of prehistoric objects from graves in Nazca, Peru, has just been augmented by the purchase of Sr. F. G. Estrada's collection consisting of 130 specimens, mostly textiles. These comprise broad and narrow ribbons, coca bags, belts, slings, etc. The prize piece of the collection is a tapestry poncho. The warp is of cotton, covered by the weft of vicuña wool yarns.

Aside from the beauty of the Nazca webs their technique never fails to interest and astonish textile manufacturers and experts. A careful examination of one piece of tapestry in the collection brought to light the fact that it contained 330 vicuña weft yarns over 42 cotton warps to the inch. Experts tell me that we seldom put in as many as 100 weft yarns of wool to the inch.

Tapestry has been defined as darning on bare warps. As many bobbins are required as there are to be colors in the fabric. Selecting the required color for the first few warps on one side of the loom, the weaver laces it in, then takes another bobbin, and so on across to the other side. In this way the designs are built up, a pick at a time, and not each formed separately. When two areas of different colors come together on parallel warps we see the slit characteristic of tapestry.

In this poncho, as in other prehistoric Peruvian textiles, the great charm lies in color schemes. In these there is never found an arrangement of colors that offends the artistic eye. The whole scheme of the decoration is taken in a high key, but the various shades of red and yellow are so soft and pleasing that we do not at first realize how intense they are.

The colors used by these ancient people were mostly made from vegetable substances, and our modern color boxes contain few that match them, as thousands of artists and design students who have worked from these textiles can testify.

To copy the poncho under consideration is, in a way, like painting a brilliant sunset from nature. The result probably will be disappointing while in presence of the original, but will seem to look much better the next day when removed from its proximity.

The design is a sort of diamond-shaped figure (truncated rhomb) enclosed in white lines, and by other white lines divided into quarters. Each quarter contains a number of figures which never change in form, although their positions and colors and those of the quarter in which they occur vary in each succeeding design. This repetition of a design in different color schemes is a characteristic of Peruvian decorative art. The colors used in the poncho are yellow, greenish yellow, dark buff, carmine-red, dull red, brown, old rose, magenta, purple, green, black, and white.

The greater part of the Peruvian coast region is a desert where rain is all but unknown, and textiles buried in the dry, nitrous sand suffer little or no deterioration. After a lapse of one thousand years or more they come from these graves as strong in texture and with the colors as bright as the day they were buried with the dead. They are found on the mummy or beside it, with such objects as were prized by the individual in life and such as it was thought would be useful in a future state.

Nazca lies about 220 miles to the south of Lima. The whole valley in which it is situated is hot and dry. The only water is from a small river that is dry part of the year, and sometimes contains no water at all for several years. About the only indigenous vegetation to be seen is algarroba trees and cotton plants. Notwithstanding these conditions there is abundant evidence that the Nazca Valley supported a large population in prehistoric times. How was food enough obtained to support so many people? This is one of the Peruvian puzzles that has never been solved. There is not the least evidence that conditions have changed in this region, yet here flourished one of the three great culture centers, the others being at Tiahuanaco and Trujillo.—CHARLES W. MEAD, Assistant Curator in Anthropology, American Museum.

Anthropology and Geology in the Pan-Pacific Scientific Conference

Report by the delegates from the American Museum, Dr. E. O. Hovey and Dr. Clark Wissler

THE first Pan-Pacific Scientific Conference for the consideration of research in the Pacific met in Honolulu August 2–20, 1920, at the invitation of the Pan-Pacific Union. The program and preliminary organization were placed in the hands of the National Research Council of the United States and were referred to the Committee on Pacific Exploration, of which Dr. J. C. Merriam is chairman. The members of this committee, not being able to attend the conference, delegated their responsibilities to Dr. Herbert E. Gregory, of Yale University and director of the Bernice Pauhai Bishop Museum at Honolulu, and Dr. Clark Wissler, of the American Museum and chairman of the Division of Anthropology and Psychology of the National Research Council, as a subcommittee. The plan submitted by this subcommittee was adopted by the conference as its scheme of organization, declaring itself to be international in scope and representing the scientific men of all the nations in and around the Pacific.

Sixty delegates were in attendance, representing the Territory of Hawaii, the Philippine Islands, Canada, Japan, England, Australia, New Zealand, and the United States of America. It was proposed that the members of this conference should constitute a general committee for the formulation of a research program for the Pacific with a view to coördinating the scientific activities of all the nations concerned. To facilitate this program a number of sectional committees were formed.

Geology and its related sciences were represented by the following delegates:

E. C. Andrews, chief of the Geological Survey, New South Wales; William Bowie, chief of the Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.; R. T. Chamberlin, professor of geology in the University of Chicago; Leo A. Cotton, professor of geology, University of Sydney, Australia; Joseph A. Cushman, director of the Boston Society of Natural History; George R. Davis, geographer, U. S. Geological Survey, Washington, D. C.; Rue H. Finch, seismologist, Hawaiian Volcano Observatory, Hawaii; Herbert E. Gregory, professor of geology, Yale University, New Haven, Conn.; Gilbert Grosvenor, president of the National Geographic Society, Washington, D. C.: E. O. Hovey, curator of geology and invertebrate palæontology, American Museum of Natural History, New York City; T. A. Jaggar, Jr., director, Hawaiian Volcano Observatory, Hawaii; G. W. Littlehales, hydrographer, U. S. Hydrographic Office, Washington, D. C.; Miguel S. Maso, seismologist, Philippine Weather Bureau; Fusakichi Omori, professor of seismology, Imperial University, Tokyo, Japan; H. S. Palmer, assistant professor of geology, University of Hawaii; Henry C. Richards, professor of geology, University of Queensland, Australia; Arnold Romberg, seismologist, University of Hawaii; Warren D. Smith, professor of geology, University of Oregon, Eugene, Ore.; C. A. Sussmilch, director, School of Technology, Newcastle, New South Wales; J. Allan Thompson, director of Dominion Museum, Wellington, New Zealand; T. W. Vaughan, geologist, U. S. Geological Survey, Washington, D. C.; R. L. Walker, oceanographer, Pearl Harbor, Honolulu; H. S. Washington, geologist, Carnegie Geophysical Laboratory, Washington, D. C.; H. O. Wood, seismologist, National Research Council, Washington, D. C.; N. Yamasaki, professor of geology, Imperial University, Tokyo, Japan.

The principal prepared addresses under geology and geography were connected with the discussion of the topic "The Framework of the Pacific," presented by E. C. Andrews, R. T. Chamberlin, F. Omori, and William Bowie; "Ocean Currents and Their Significance," discussed by Paul Bartsch, G. W. Littlehales, G. F. McEwen, and N. Yamasaki; "Volcanism in the Pacific," discussed by T. A. Jaggar, Jr., and H. S. Washington; "Seismology in the Pacific," discussed by F. Omori and H. O. Wood; "Mapping the Pacific," discussed by William Bowie, G. W. Littlehales, and G. R. Davis.

Resolutions adopted as an outgrowth of the conferences urged, among other things, the prosecution of geological surveys of critical insular areas in the Pacific Ocean; emphasis was placed upon the importance of coöperation among the different geological workers in the Pacific region, and the establishment of a central scientific bureau for the dissemination of volcanic and seismologic studies was earnestly advocated.

In anthropology, the sectional committee, in conformity with the policy of the conference, undertook the formulation of a plan for the development and coördination of anthropological research in the islands of the Pacific, particularly in Polynesia. Polynesia was emphasized because the section received a formal request from the trustees of the Bishop Museum in Honolulu for detailed recommendations for the organization of their own investigations in Polynesia, for which funds have recently been provided. It proved impossible to complete the work of the section during the three weeks allotted, but provision was made for the final formulation of its recommendations under the direction of the section officers.

The conference held daily sessions, giving the entire morning of each day to the principal sciences concerned in Pacific research. These sessions were attended by the whole conference and the discussions freely participated in. One entire morning was given to anthropology, the presiding officer being Dr. Frederick Wood-Jones, of the University of Adelaide. The formal presentations were as follows:

Clark Wissler, "The Chronological Problem in the Pacific"; A. L. Kroeber, "Peoples of the Philippines"; L. R. Sullivan, "The Racial Problem in Polynesia"; A. M. Tozzer, "Race Mixture in the Pacific"; J. F. G. Stokes, "Distribution of Culture Traits in the Pacific as Illustrated in Featherwork"; T. G. Thrum, "Polynesian Archæology."

The anthropological representation in the conference included:

United States: Clark Wissler, A. L. Kroeber, A. M. Tozzer, Gerard Fowke, L. R. Sullivan, R. T. Aitken. Territory of Hawaii: W. T. Brigham, J. F. G. Stokes, T. G. Thrum. Australian: Frederick Wood-Jones. New Zealand: J. Allan Thompson. Philippine Islands: No anthropologist accompanied the Philippine delegates, but the subject was represented in the section by E. D. Merrill, director of the Philippine Bureau of Science. Japan also sent no anthropologist, but the work of Japanese anthropologists was presented by Dr. N. Yamasaki, professor of geography, Tokyo Imperial University. Dr. K. Kishinouye, the celebrated Japanese zoölogist, who has made a special study of Japanese shell heaps, also took a prominent part in the meetings of the section.

Objects That Symbolize the Common Life in Tibet

With reference to a new and very valuable collection recently obtained by the American Museum from southern Tibet

THOSE who are in the habit of visiting the anthropological halls of the American Museum to study the customs of far-away peoples will be glad to learn of a recent valuable accession from Tibet.[1] The collection was made by a medical missionary, the Rev. H. B. Marx, through a period of sixteen years' residence at a Moravian mission on the southern Tibetan border. The mission buildings are on the Indian side, suffice it to say, not on Tibetan soil, and that Dr. Marx has been able not only to maintain cordial relations with this unfriendly country, but also to bring together a collection of objects representing the common life there, reflects on both the high character of his personality and the gratitude the Tibetans have felt for the medical service he has given.

The Tibetans have always borne toward the rest of the Orient excessive exclusiveness both political and religious, especially during the nineteenth century and later when elsewhere civilization has been rapidly advancing, which leaves them today in the anomalous position of a living but almost fossil race. Even their country, a million miles square and the highest of the globe, with valleys ranging from 12,000 to 17,000 feet above the sea, is little known. From India at the south they have kept a commanding barrier by the almost unscalable mountains—as well as by their aggressive, suspicious nature and very different social life. Dr. Marx, however, from the mission at Poo, India, was allowed to penetrate considerable distances in different directions, and the collection which he has brought out has been selected with thought for high scientific value in depicting national custom.

The tea-drinking habit in Tibet, for instance, is suggested in the paraphernalia for making "buttered tea": a low table of red and black lacquer (behind which the Tibetan sits with crossed legs on the floor or on a small woolen rug of Tibetan weaving); either a wooden or a china cup for the tea, with a metal saucer-like stand and a cover; the teapot of brass or silver, attractive in shape and elaborately decorated; and the small churn with metal ornamentation. The hot tea is mixed with rancid butter and ground barley into a kind of broth, the so-called buttered tea, or perhaps is compounded with a larger amount of barley into small brown cakes. That the cup fits into a covered metal box and the table collapses into a form convenient for transportation intimates the habitually large amount of slow travel there is in Tibet by primitive methods from one remote center of population to another. Tea is imported from China in enormous amounts. The official report of duty covers the entrance of more than ten million pounds annually. Most of this is of an inferior quality, compressed into large bricks of about five pounds weight, which are so universally used throughout the realm that they have come to be passed as currency.

One can read correctly very much of the life of the Tibetans from these isolated objects. Hobbles, stirrups, and racing harness tell the very considerable part the Tibetan ponies take in pastime and travel; the woolen industry is illustrated from clipping the wool through spinning and weaving to the finished shawl. There are bleeding cups and crude lancets and the like to reveal the primitive state of medicine and surgery; pipes, bags, and boxes explain the large use of tobacco and opium; and there are various musical instruments, the oboe of the beggars, the primitive guitar and flute, and especially the drum and bell of the noisy music of the lama festivals.

It would be evident from the collection,

[1] Presented through the generosity of Mr. J. P. Morgan, New York City.

SUGGESTIVE OF THE PREVALENT
TEA-DRINKING HABIT
IN TIBET

The teapot is of Chinese importation. The Tibetans do not make any ornamental metal work. The table of red and black lacquer spreads out into considerable size or collapses into form convenient for transportation on the long, slow journeys the Tibetans make over their inhospitable and thinly settled country. Also, the bowl for tea fits into a covered metal box (at the left) for safety during travel. "Buttered tea," a staple food in Tibet, is made by mixing hot tea with rancid butter and stirring into this ground barley to broth consistency—or in larger amount to form small cakes

LAMA COSTUMES WORN IN A CEREMONY FOR "DRIVING OUT THE DEMON"

At the left are the musicians with drum, cymbals, and bell. One lama carries the lasso to catch the fleeing demon, a second the chain to bind him, a third the skeleton club to deal the death blow, a fourth the sacred lama dagger and the skull in which is caught the blood to serve as a vigor-giving drink to the lama. This fourth lama (at the right) is wearing the very sacred mask of the five skulls, representative of slain demons, and the breast regalia of carved lama bones. The ceremonial robes are of heavy silk, gold embroidered. These objects are all in the possession of the American Museum, which hopes at some time in the future to build a group depicting the demon dance in the court of a Tibetan temple (see page 472)

too, that religion plays a large part in the life of Tibet, and that this religion[1] tends toward sorcery, ritualism, and magic. There are clay idols and the copper molds for making them; there are amulets for protection against sickness, bad dreams, and fears in the dark, or to be worn during what they consider the "dangerous" years of life, a dozen years apart (thirteen, twenty-five, thirty-seven, forty-nine, sixty-one, seventy-three); there are nuns' rosaries carved in shell; a prayer wheel is filled with a sheaf of thin round leaves of paper, each printed with many repetitions of a common prayer, ready to be brought by the whirling of the wheel to the attention of the Merciful One begging him to have the world in mind and help all human kind; there is a prayer stone with its engraved prayers, such as cover the stones in the thousands of prayer walls in Tibet, all addressed to the same Merciful One for the good of mankind.

Sacred relics called "potted lamas" intimate the strong barbarous element in a people saturated in the horrible incident to life and death. These objects are made of crushed human bones and clay, referring to the Tibetan custom of disposing of their dead priests by throwing aloft small portions of the flesh cut from the body to be caught by the circling birds of prey, and crushing the bones to be mixed with clay and pressed by means of metal molds into these relics.

[1] The religion of Tibet is a combination of old savage demon worship and modern Buddhism.

The collection contains the powerful lama dagger carried in a ceremonial dance of the lamas called "driving out the demon." The dancers, called "demon dancers," represent the warriors of Tibet's ancient demon worship. There are the lasso used by the warrior to catch the fleeing demon, the iron chain which fetters him, the skeleton club which deals the death blow, and the skull in which is caught the blood to serve as a vigor-giving draft to the warrior.

All these objects, together with the masks and the silk and gold-embroidered robes of symbolic colors worn by the officiating lamas in the ceremony, are a part of the new accession. The museum will have under consideration the possibility of exhibiting them at some time in the future, with the assistance of Dr. Marx, on figures in an anthropological group, thus portraying one stage in the demon dance just as it takes place in the court of the Tibetan temple. Fortunately for this, the collection contains also the regalia consisting of ornamental apron and breastplate made of carved bones of sainted lamas; and also the very sacred mask of the five skulls, representing slain demons, which is worn by the lama who carries the sacred dagger. This ceremony and many of the others of Tibetan religious festivals performed by the lamas, it is said, present a considerable analogy to various mediæval mystery plays.—THE EDITOR.

Sacred Tibetan relics molded from clay mixed with the crushed bones of sainted lamas. Such objects, together with prayer wheels, prayer stones, and the like, are suggestive of the large part religion plays in the common life in Tibet.—a combination of ancient demon worship and modern Buddhism

Three-toed Horses[1]

A FOSSIL RECORD THAT PROVIDES DIRECT EVIDENCE OF EVOLUTION

By W. D. MATTHEW

Curator of Vertebrate Palæontology, American Museum

THOSE who are familiar with Macaulay's *Essays* will recall the way in which he makes the review of some book a peg on which to hang a learned and brilliant discussion of the whole subject to which the book relates. That, in a way, is what I intend to do here—omitting the adjectives—as it is convenient to adopt his method for the present essayette and to use Professor Osborn's monograph as a text.

This memoir is in fact a very elaborate, although by no means a complete account of the three-toed horses of America, very thorough and authoritative, and admirably illustrated. Every described species is recorded, with the original figures and the essentials of the original description refigured and redescribed where there is occasion, its geological formation and locality exactly given, and referred to its proper relations as now understood. In addition, a great number of new species or specimens are described and figured, much more complete than the fragmentary types on which early studies were based. Diagnoses of the genera are given, and the systematic revision is preceded by an account of the formations in which the various species have been found and their correlation, and an all too brief discussion of the structure of the molar teeth in the three-toed horses.

The incompleteness of the memoir consists in its failure to describe or even mention the great bulk of undescribed material, prepared and partly studied and identified, in the American Museum and elsewhere. Foreign students quite fail to realize the existence of this unpublished material and the important bearings that it has on problems of migration and distribution.

The volume is essentially a record of facts. Professor Osborn has throughout avoided discussion of the theories and conclusions relating to the evolution of the horse and cognate subjects which he has so luminously and extensively treated elsewhere. It presents the foundation of material evidence on which such theories are based, and as such it is invaluable to all future researches in this subject, although too technical for the amateur or superficial student, and not intended for the general reader.

What were these three-toed horses anyway? Why are they so important or so interesting that literally thousands of scientific papers have been written about them and that so busy a man as Professor Osborn can find time to prepare this elaborate memoir for the help of future students?

Briefly, they are thus important because they afford one of the best records by which to test the truth of the theory of evolution.

The theory of evolution—commonly but wrongly called "Darwinism"—is an attempt to explain the present diversity of living beings and their various resemblances and differences in structure as due to their descent from common ancestors and the slow, gradual changes in each race in adaptation to its particular mode of life. The doctrine of natural selection—Darwinism properly so called—gives as the cause of these changes the gradual accumulation through innumerable successive generations, of such minute differences as we find always exist between individuals and tend to be inherited by their offspring.

All the evidence for evolution found in the anatomy and structures and habits of animals, in their relationship and distribution, in the growth and development of the individual, in the breeding and selection of domestic animals and of plants, and in the so-called "experimental evolution" which has converted into a science the practical knowledge of the breeder, is, after all, indirect evidence. However uniform its inferences, however overwhelming its weight, however perfectly and admirably it explains innumerable details of structure and habit for which no other reasonable explanation can be found, it would be as nothing if palæontology were against it. If the actual remains of fossil animals showed that they

[1] "The Oligocene, Miocene, and Pliocene Equidæ of North America." Iconographic Revision by H. F. Osborn. *Memoirs of the American Museum of Natural History*, Series II, No. 1, issued 1918.

had always been as they are now since they first appeared on the earth, then, indeed, we would have to sweep aside the beautiful theory of evolution with all the exquisite perfection of its explanations of every tiny detail in the complex structure of the higher animals, as an iridescent dream. We would have to say to the anatomist, to the embryologist, to the experimental evolutionist: "Oh, yes! Your interpretations and analogies and experiments are ingenious and interesting, but you can't prove evolution by them for they are in conflict with the plain facts. The record of what actually has happened shows that species *did not* come into being that way. They were created in the beginning just as they are."

But the fossil record, this plain, direct, and unalterable record of what *did* happen during the past history of the earth, *does* prove evolution, and wherever it is complete enough, it proves it so directly and conclusively that it removes it from the category of theories to that of facts. It is, indeed, a very incomplete and fragmentary record. It owes its preservation and existence rather to the chapter of accidents than to the normal cause of circumstances. But, whenever there is anything approaching a consecutive detailed record of any race or type of animal, it becomes perfectly evident that the race or type has not come into existence in its present form, but has changed through numerous small or minute gradations from an original type which is hardly or not at all distinguishable from the original form that gave rise to other races or types of animal now widely different.

In brief, we may compare the history of animal life to a tree. The modern animals, separated and distinct in varying degrees and in varying directions, represent the tips of the upper branches. As we follow them down, guided by the geological record of past faunas, we find the separate twigs united, then the larger branches, and finally, if the record would carry us that far, the great boughs or primary branches would come together in the one trunk which is the primitive beginning whence they all arose. In addition to the branches which have survived to the present day there are many branches, great and small, and innumerable twigs, that have become extinct at various epochs in the past. Such is the picture that we build up from the glimpses of the past history of life vouchsafed to us by the record, graven in stone, immutable and unforgetable, that is set before us.

The authenticity of these "documents," as the French are fond of calling fossil specimens, cannot be challenged save by the ignorant. It is perhaps not known to everyone that it is the structure, not the form of a fossil bone that proves it to be authentic. Its form can be mimicked, its peculiar structure it is impossible to imitate artificially, nor does nature ever produce anything else resembling it. Historical documents may be forged. Nature's documents cannot.

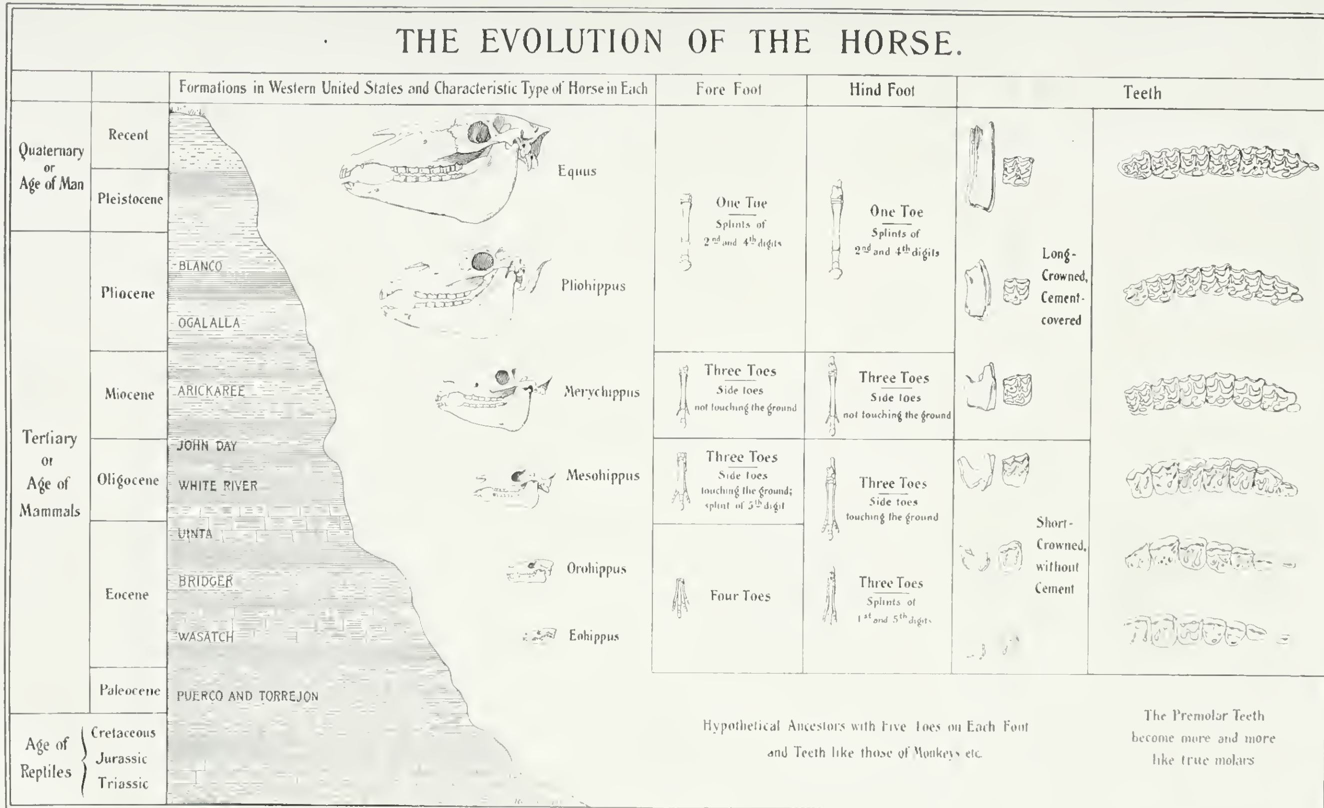
It is true that the geological record of successive stages may sometimes be inexact or incorrect. The succession of the geological formations is determined by the fact that one overlies or overlaps another. Obviously the one on top must be of later age, unless the world has been turned upside down in that particular region.[1]

But sometimes the formations are in different regions and cannot be directly connected up. In such cases we have to rely on other and less conclusive evidence, and mistakes may be, and have been, made. The earliest serious study of fossils showed, however, that certain formations were characterized by certain kinds of extinct animals, and that these fossils were found only in those strata; above and below they were replaced by other species, related but distinct.

This fundamental fact has been verified by a century and a half of research. It can be verified again by anyone who will take the trouble to go out into the field and collect fossils. No one would be more prompt to report an exception than the scientist; for such a discovery would make him famous. But no real exception has ever been found. No species whose structure is sufficiently complex for its fossil remains to show the traces of change persists wholly unaltered through any considerable portion of geological time.

The geological record is a grievously incomplete one. For the most part it must be built up—as is the historic record—by comparison and deduction from documents

[1] There really are such cases in the Alps and other mountain regions, where a succession of strata is tipped up on edge and occasionally actually overturned. How such overturns occur and how they are recognized is explained in geological textbooks.



The ancestry of the horse and the slow general development to the species known today afford one of the most complete fossil records by which to test the theory of evolution. Here is told a plain, straight story of what *did happen* during the past history of the earth.

The illustration, read from the bottom up, indicates this evolution from early geological periods (at the left), with continual increase in size of the horse as represented in the column of skulls, decrease in the number of toes as shown in the drawings in the middle two columns, and change of the premolars from a short-crowned condition without cement to long-crowned cement covered teeth very like the molars preserved. Fortunately we do not have to dispute their authenticity and seldom to question their provenience. But there may often be doubts of their exact significance. It is only here and there, in certain groups of animals and for certain portions of their history, that our "documents" are complete and abundant enough to prove directly the evolution of the race. The best evidence of this sort is to be found among the invertebrates, especially among mollusks, which include many cases where the gradual change in a race can be followed by numerous specimens from each stratum.

But while the evidence of these invertebrates affords conclusive proof of evolution to the palæontologist, it is not always convincing to the layman. Many people may be willing to admit that one species of clamshell has changed gradually into another, but they will deny vigorously that a horse and a tapir are descendants of a common ancestral stock, and angrily resent the imputation that they themselves are blood relatives of the chimpanzee and the gorilla. Such a position is illogical, if they only knew it, for if the proofs of evolution in the anatomy of the lower animals are shown to be in accord with the facts of their past history, then the much stronger evidence in the anatomy of the higher animals must mean the same thing in their case. But it is natural enough, for the objections to evolution center around the descent of man, and the average anti-evolutionist will hardly see that his traditional view is endangered by anything so remote as the humble mollusk.

The evolution of the horse, however, comes near enough home to shake his confidence if he is opposed, or to assure his belief if he is in favor of the theory of evolution. It is not the record in which we are most interested, namely, that of the evolution of our own race. But it is that of one of the most familiar domestic animals, the changes in the structure of the skeleton are obvious and the reasons for them easily understood, and the record of the evolution of the race is a fairly complete one so far as it goes. A brief sketch of the facts in the case may be in order.

The modern horses, asses, and zebras form a little group of animals very much alike save for differences in size, in color, and in surface markings, and still closer together in all the details of their skeleton construction. The skeleton, while it has the general characters common to all the higher quadrupeds and man, is characteristically different and peculiar in many particulars, especially in the construction of the head, of the teeth, and of the feet.

By comparing the skeletons of horse and man as shown in the group at the front of the Horse Alcove in the American Museum, one can see that the bones of the skeleton correspond throughout and have the same relations, but differ very widely in proportions and form. The head of the horse is nearly all face with long jaws and comparatively small brain. The head of the man is chiefly brain case, the jaws very short, and the face relatively small. The horse has a long neck and deep trunk, the man a very short neck and wide trunk. The tail in man is reduced to an obscure vestige. The shoulder blade in man is wide and short with a collar bone bracing it against the breastbone. In the horse the shoulder blade is long and narrow and there is no collar bone. The pelvis in man is a wide, capacious basin that aids in the support of the internal organs. In the horse it is a sort of rack on which the powerful limb muscles are fastened. The limb bones in man are long and loose-jointed, in the horse short, compact, with tight joints that permit of but limited movements—but much more powerful. The outer bones of forearm and shin (ulna and fibula), complete and separate in man, are incomplete in the horse and consolidated with the inner bones (radius and tibia). But it is in the feet that the contrast is most obvious. The wrist of man corresponds to the "knee" of the horse's fore leg, and the ankle to the "hock" of the hind leg. But instead of the short, spreading hand or foot of man with its five digits, the horse has a long, slender foot, composed of only one complete digit, corresponding to the middle finger or toe in man with rudiments of the second and fourth digits known as splint bones. And it is quite literally true that the horse walks upon the tips of its finger nails, for the hoof, not preserved in the skeleton, is the representative of the fingernail or toenail of man.

The object of these contrasts is evident. In the horse the limbs are adapted solely for locomotion on all fours, and especially over open ground. Speed and endurance are gained by lengthening the lower ends of the limbs, stepping upon the tips of the toes, and concentrating the weight upon the middle toe. The superfluous parts have disappeared. In man the hind limbs are the sole organs of locomotion, but in order to maintain a steady upright pose, it is necessary to keep the heel on the ground, and the wide sole and short spreading toes are suited for travel over rough ground or in the forest. The fore limbs, released for purposes of grasping and holding objects, have become specially adapted thereto.

The teeth of horse and man are equally in contrast. In man they form a continuous semicircular row, thirty-two in number, all of them very short crowned, the molars with a flattened crushing surface, the front teeth with cutting edge, the others intermediate. In the horse the teeth are more numerous, thirty-six or forty according to sex (the canine teeth are usually absent in the female), with occasional rudiments, "wolf teeth" of the first premolar, that if all present bring the number up to forty-four. The front teeth are separated from the cheek teeth by a wide gap; and all the teeth, but especially the cheek row, have very long, or rather high crowns, which keep on growing in the jaw as their surfaces are worn down. The grinding surface shows a very complex structure or *pattern* of crests of hard enamel alternating with softer dentine and "cement" which serves to prevent the surfaces from wearing smooth and makes it effective in triturating the food.

The reason for these differences in the teeth is not far to seek. Our food requires but little chewing; cutting off in morsels and a moderate amount of crushing suffice; and there is consequently no great wear on the surface of the teeth. The food is conveyed to the mouth by the hands (with or without the aid of implements) and there is no need for a projecting muzzle. The horse, on the other hand, feeds upon grasses that require thorough trituration, and needs the magazine of powerful cheek teeth, which are worn down rapidly and must be renewed as they wear, else the life of the animal would be but a short one. It must use the front teeth for seizing and cropping the grass, and their advanced position and clipping edges are adapted to that purpose. The intelligence of the horse is highly developed along certain lines necessary to his mode of life. His place- and road-memory are remarkable, for in nature he must daily travel long distances to obtain water, food, and security from attack. His eyesight is keen, his sense of smell far more developed than in man; but in reasoning powers and the higher faculties he does not approach the human standard.

Horse and man are sharply contrasted types among the higher vertebrates in structure and adaptation. Most other mammals are more or less intermediate, but each specializes in various ways and in varying degree in adaptation to its particular mode of life. These specializations are in general most clearly seen in the structure of feet and teeth, which, as Professor Osborn has remarked, are the organs through which the animal comes most directly in contact with its environment. The correspondence between structure and habits in all animals is apparent in innumerable details. Whether the structure is adapted to the habits or, as the palæontologists believe, that there was a gradual coadaptation of both from Primitive common ancestry to the various specializations, whether all structures are in some way useful or advantageous to the animal—these and many other interesting problems belong to the theoretical side of evolution. It is with the facts that we are here concerned.

The horse family stands wide apart from any other group of living animals. The ruminants, which resemble them most in form and habits, differ greatly in the details of their construction. Cattle have long crowned teeth and long slender feet, walking upon the tips of the toes like horses. But the pattern of the grinding teeth is fundamentally different, and the foot is composed of two digits conjoined instead of a single digit as in the horse; and throughout the structure of all ruminants runs a series of superficial resemblance to the horse based upon underlying differences. On the other hand, the tapir and the rhinoceros, superficially very different from the horse, show an underlying resemblance which long ago caused comparative anatomists to unite them into a single order of the Mammalia.

The palæontologist has since shown that these resemblances are due to relationship, that all three are descended from a common stock that existed about the beginning of the Tertiary period and have gradually diverged each in adaptation to its special mode of life. The record of the evolution of the horse, so far as known, is a record of its progressive specialization from that common stock. That stock was already distinct from the stock that gave rise to the ruminants, pigs, and hippopotami, from the stock that gave rise to the various kinds of Carnivora, and from the ancestral stock of lemurs, monkeys, apes, and men, as well as from a number of other primitive stocks of less interest. Could we follow these stocks further back in time, for another geologic period or so, we should doubtless find that they in turn are derived from a more ancient common stock. But the records to prove this have not yet been unearthed; it remains a matter, not indeed of doubt, but of theory and inference rather than of fact and record.

The present distribution of the horse family, aside from domestic horses, is limited to Africa and central Asia. In the latest geological formations, however, of the Pleistocene epoch, we find fossil remains of various species of horse in all parts of Europe, Asia, and Africa, North and South America. These species are all closely related to the existing horses, one-toed, and with teeth entirely similar to the modern species.

In the next preceding epoch, the Pliocene, we find fossil horses both in the Old World and the New, and some of them in the later part of the Pliocene of Europe are also closely related to the modern horse and are placed in the same genus, *Equus*. In the Lower Pliocene we find three or more genera all evidently related to the horse but of smaller size, with the side toes less reduced, completely formed in some species. In the Miocene there are numerous species, all of them with the side toes complete but small and slender, seldom reaching the ground. They average about the size of a donkey, and their teeth are shorter crowned than in the later horses. In the Oligocene the horses are still smaller, averaging about the size of a sheep, the side toes are less reduced so that they reach the ground and help support the animal, and the teeth are comparatively short crowned with simpler pattern. In the Eocene the horses are still smaller, averaging about the size of a terrier dog, their side toes are quite large, and in the forefoot there is a fourth digit, so that these are known as "four-toed horses." The teeth are still shorter crowned and simpler in pattern.

These are merely the outstanding stages in a long succession of intermediate gradations that connect the modern horse with the little four-toed *Eohippus* of the Lower Eocene. Each gradation is found in its appropriate geological stage, and not earlier or later. The changes and gradations are seen just as clearly in every bone of the skeleton as in the feet and teeth, and the gradual evolution of the race is thus shown by direct and overwhelming evidence. You may indeed, if you choose, declare that each successive gradation was independently created. Direct proof on that point is not at hand; the genetic continuity rests upon inferential evidence. But that the race as such evolved gradually, little by little, through the millions of years of the Tertiary period, is a matter of plain fact and record.

It is equally a matter of record that the now diverse types of tapirs and rhinoceroses evolved gradually from a common ancestral stock with the horses; and that all the records of other races of mammals show them converging backward in time toward a common stock. The *Eohippus* is by no means as different from man as is the modern horse and he is far closer in every detail of his construction to the Eocene representatives of the group to which man belongs (the Primates) than he is to man. All other races of animals display the same convergence toward a common ancestry in every detail of the teeth and feet and skeleton.

The evolution thus shown as a fact of record in certain portions of the history of various races which have been preserved to us in the history of life, appears to be a sure inference as applied to the whole, supported as it is by the community of fundamental structure that prevails through the whole living world, by the obvious adaptation of each race to some particular habit of life, by the proof that natural selection can and must operate to bring about changes in the structure of the race in adaptation to its habits. If we recognize that the records, where they are preserved, show evolution to be a fact, we cannot logically refuse to admit it in the undiscovered portions of the record, upon the force of the immense amount of inferential evidence in its favor, and, in conclusion, because it is the only real explanation of life, the only one that rests upon natural law.

A SCIENTIFIC RECORD FROM THE NEW YORK ZOÖLOGICAL PARK

An instance of phenomenally rapid growth of the true bone of vertebrate animals

SHEDDING AND RENEWAL OF THE ANTLERS OF AMERICAN ELK OR WAPITI SHOWN IN A DEVELOPMENTAL SERIES OF REMARKABLE PHOTOGRAPHS NOT PREVIOUSLY REPRODUCED, BY MR. ELMER SANBORN, PHOTOGRAPHER FOR THE NEW YORK ZOÖLOGICAL SOCIETY (MR. SANBORN HAS DEPICTED THIS GROWTH ALSO IN A SERIES OF MOTION PICTURES)

SEMIDOMESTICATION IN THE NEW YORK ZOÖLOGICAL PARK

American elk antlers consist of two branching round and solid outgrowths of true bone. They are shed each year and their immediate renewal is a phenomenon of astonishing rapidity of bone growth.

Shed antlers are often found in elk territory. Theodore Roosevelt called his ranch on the Little Missouri "The Elkhorn" because shed antlers were numerous on the ground both in the surrounding bottoms and among the hills, sometimes many score in a small area indicating where had been a great winter gathering place for elk

AMERICAN ELK ANTLERS ARE SHED

And there is revealed the top of the pedicel or bony prominence from the skull on which they grew

The perfected antler is dead bone and has no blood supply except at the base where it is attached to the pedicel. The blood in the vessels which penetrate this circular stratum between the living bone of the pedicel and the dead bone of the external antler, gradually, through a few weeks' time, by an absorbent action, takes out the mineral elements and creates an irregular layer of bone so porous that the strength of the whole antler is undermined. Thus the heavy, bony outgrowth finally falls away because of its own weight or is knocked off by some light blow against tree or fence.

Immediately the membrane or periosteum which covers the sides of the pedicel grows up to cover the top where the antler has broken away; also a thin, dark skin, bearing a short fur, outside of the periosteum grows upward to cover the exposed top of the pedicel.

It is only in the semidomestication of the zoölogical park or private preserve that the actual dropping of the antlers and the rapid new growth which follows can be observed in detail

AND THEY ARE RENEWED

Stages in the progress of a growth which requires less than six months for the development of the antlers to the full-grown condition again

A CIRCLE OF VELVET HORNS

After the periosteum covering the sides of the pedicel, and the skin with its fine fur or "velvet" over that, have extended to cover the top of the skull prominence, the period of remarkable growth sets in. The periosteum is filled with arteries, also a great artery comes up through the core of the pedicel, and these carry so rich a supply of nourishment that the outline of the new antler soon rises into being. Other arteries from the periosteum penetrate into the substance of the new growth at the point of union of the antler with the pedicel. Almost at once the growth shows division into two parts: the posterior, the beam which is to make the elongated axis, and the anterior, the "brow tine"; also immediately the beam divides into two (see photograph on preceding page). The new growth hardens and stiffens through a deposit of bony substance from the blood, and by a still greater and greater deposit, changes from a very porous condition to that of firm and solid bone. The periosteum carries also a rich nerve supply, so that the soft, growing tips of the antlers are highly sensitive and are instinctively protected by the elk from any contact. At the stage of development presented above three tines have been formed and the backward-projecting beam is continuing its growth

APPROACHING COMPLETION BUT STILL "IN THE VELVET"

From the earliest growth to the perfected state the antler, with its artery-filled periosteum, is covered by the protective velvet. In the stage presented here, three tines have been thrown off and the beam has broadened, flattened, and divided for the fourth forward-curving tine. It is not surprising that such antlers, with their astonishing growth, branched structure, and "mossy" appearance, should nave been described by very early naturalists (Buffon for instance) as "vegetable products" growing like shrubs on the animal's head

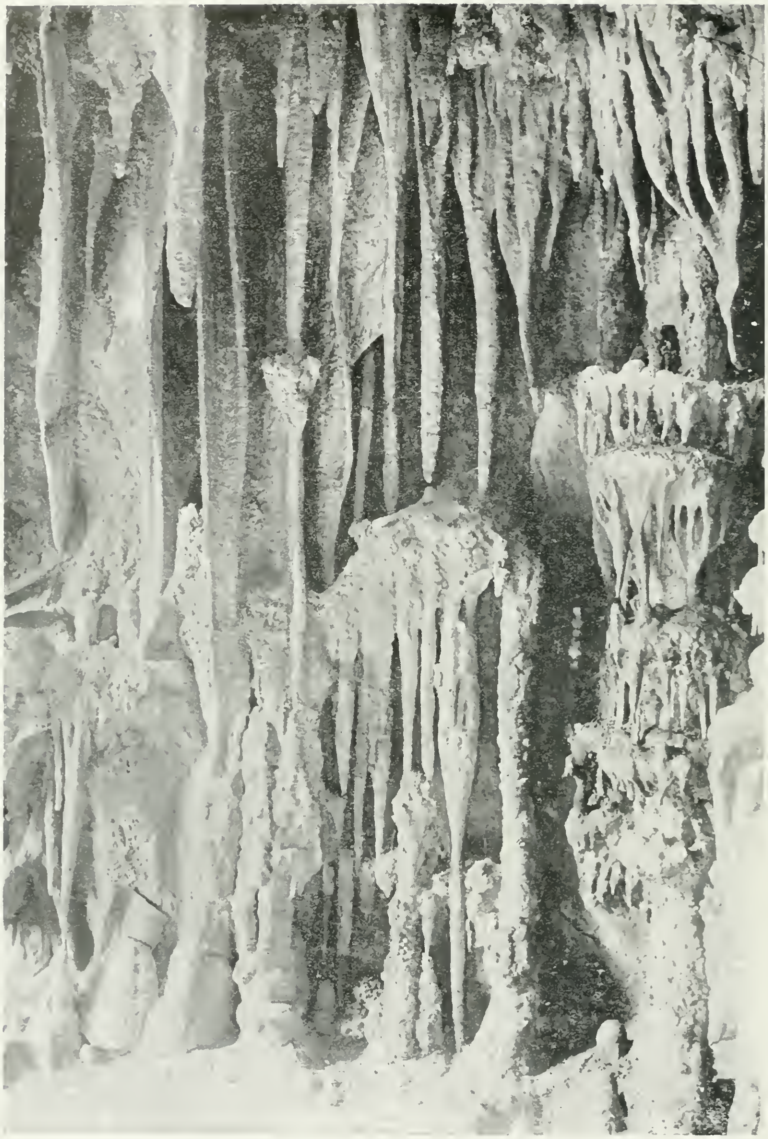
THE VELVET SHREDS AWAY

And the antlers of hard white bone are revealed

Finally the growth is completed. The veins in the interior of the bone which carried back the blood flow from the arteries of the outside velvet, cease to function. The nervous irritation to the animal is considerable until these arteries likewise stop their work. The process is hastened by the elk, which rubs the antlers against fence, tree, or other near object, so that the torn velvet hangs in shreds and wholly drops away, disclosing the white bone

PERFECTED ANTLERS OF AMERICAN ELK

It is said that our American elk have vanished from fully nine-tenths of the country over which they ranged a little more than a century ago—next to the buffalo the most conspicuous instance of game extermination in America. The species has not been known for 150 years in the northern part of its former range, where this range overlapped that of the moose. The last record of elk-killing in Pennsylvania was in 1869; in Illinois the last individuals were seen about 1820; between the Mississippi and the Rocky Mountains, where the Lewis and Clark Expedition found prosperous herds, they were killed out before the early eighties. The final stand of the species is in certain restricted areas of the Rockies. When driven by starvation from this stand, they have no place to flee to—as instanced lately in the slaughter when they tried to seek refuge in Montana. The naturalist in charge at Yellowstone National Park states that the number in the herds that come to the summer feeding grounds, heretofore placed at 45,000, must be corrected to 25,000



A CORNER IN WEYER'S CAVE, VIRGINIA

A portion of the reproduction in the American Museum of one of the grottoes in Weyer's Cave, of the Shenandoah Valley

The fantastic adornment of stalactites abounding in such limestone caverns is shown. As the water, heavy with dissolved bicarbonate of lime, seeps through the roof and falls in drops from the ceiling, it loses some of its carbonic acid by evaporation, causing the precipitation of the excess of carbonate. This precipitate accumulates slowly, forming tubular stalactites or, when the water drips to the floor, conical solid stalagmites. Some of the giant stalactites of Mammoth and Wyandotte caves must be at least one hundred thousand years old.

The material for the American Museum exhibit, presented by the "Grottoes of the Shenandoah Company," was collected from the cave by Messrs. W. B. Peters and P. B. Hill, of the museum preparation department, during 1913 and 1914, and has been installed by Mr. Peters under the direction of Dr. E. O. Hovey

Weyer's Cave Exhibit in the American Museum

WEYER'S Cave, Virginia, lies on the edge of the town of Grottoes in the Shenandoah Valley, and has long been famous for the variety and beauty of its dripstone formations, for the grandeur of some of its halls, and for the daintiness of its nooks and corners. Many such caves, though few so beautiful, are to be found in Virginia, Tennessee, Kentucky, Indiana, and other regions of heavily bedded limestone. A reproduction of a nook in Weyer's Cave has been installed in the hall of geology of the American Museum, with material taken with great difficulty from a chamber seventy-five feet above the floor of the cave. This cave may be considered a typical example of a limestone cavern in a region of abundant annual rainfall. Surface water, acidulated by carbon dioxide from the atmosphere and other acids from the ground, works its way into and along jointing planes and fissures in the limestone and forms larger passages, tunnels, halls, and chambers by solution, "levels" of which, in the miner's use of the word, are established along and above the occasional insoluble and nearly impervious layers of shale which are interbedded with the limestone. Often these open passageways and rooms attain larger dimensions. The "Hall of Statuary" in Weyer's Cave is three hundred feet long, thirty feet wide, and sixty feet high. "Rothrock's Cathedral" in Wyandotte Cave, Indiana, is a circular room three hundred feet in diameter and 135 feet high to the middle of its dome-shaped ceiling. The halls and connecting passages of Mammoth Cave, Kentucky, have been explored for more than two hundred miles of their ramifications on different levels.

With a change in local admission of water to a cave the process of filling the openings with dripstone begins. Dripstone is the name given to both stalactites and stalagmites. A stalactite starts as a paper-thin ring, perhaps a quarter of an inch in diameter, deposited from a drop of water on the ceiling. The drop is pushed off by a new drop behind it and falls to the floor. The new drop adds its paper-thin ring to the first and falls to the floor in its turn. This slow process goes on forming an open tube depending from the ceiling. Sometimes these pipestem tubes are long; one of them exhibited in the J. L. Mohler collection in a case near our grotto at the American Museum is more than a yard in length. Usually, however, the initial tube becomes clogged with crystalline calcite after a few inches of growth in its simple form. The water then flows over the exterior of the tube, depositing its excess load of mineral as a thin layer, which gradually changes the tube into a sharp or blunt cone, hanging point downward. Still there is a drop of water at the apex of the cone, which keeps on forming a tube for the center of the stalactite. A polished cross section shows the concentric rings and layers produced by this process. When the drop of water from the point of a stalactite falls to the floor, it flattens out and deposits only a thin layer of lime carbonate. The next drop adds its quota, and thus is piled up a cone (stalagmite) which usually is much more blunt than the corresponding stalactite, often being rounded or saucer-shaped at its apex. It has no tube, either open or filled, in its center.

This is the simplest description of the process; the conditions of local action produce endless changes in form of deposition, and the wealth and variety of these dripstone formations in some chambers are well illustrated in the American Museum exhibit. When the dripping water carries pure lime carbonate in solution, the resulting dripstone is colorless or white, but often the stalactites and stalagmites are reddish or brownish in color or are banded with these colors, which are due to the presence of minute quantities of dissolved iron oxide. Or, again, clay is deposited over the dripstone during the passage of excessive amounts of water. In some mining regions other colors result from the presence of salts of copper or other metals.

Weyer's Cave, so the story goes, was discovered in 1806 by Bernard Weyer when he was hunting a groundhog which had taken refuge in a fissure in the limestone. Mr. Weyer's pick and shovel opened the way into a cavern which later became one of the famous sights of the Old Dominion and has always been a favorite resort, although partly eclipsed in popular esteem of late years by Luray Cave, forty miles northward in the same valley, which was discovered in 1878.—EDMUND OTIS HOVEY, Curator of Geology and Invertebrate Palæontology, American Museum of Natural History.

A Botanical Excursion to the Big Cypress

By JOHN KUNKEL SMALL

Head Curator of the Museums and Herbarium of the New York Botanical Garden

THE most extensive physiographic trinity or the largest prairie-marsh-swamp region, and at the same time the least known area in the eastern United States, is in southern Florida. The "Big Cypress," or the Big Cypress Swamp, lies south of the Caloosahatchee River between the Everglades and the Gulf of Mexico. The greater part of our population is ignorant even of this geographic designation. To the few who have seen it printed on maps the name signifies nothing, or conveys but a vague idea. Only a score or two of surveyors, hunters, and prospectors, out of the hundred million inhabitants of the United States, have any definite knowledge of its physical geography.

The second week of May, 1917, we were on the very edge of the Big Cypress when we navigated Lake Hicpochee during a cruise to Lake Okeechobee. The day we returned from that cruise, which was described in former papers,[1] an opportunity to explore some of the mysteries of the Big Cypress unexpectedly presented itself. Mr. W. Stanley Hanson, a bird inspector with the United States Biological Survey, and a naturalist well acquainted with the Big Cypress, had come to Miami across country from Fort Myers, whence he was about to retrace his course. The opportunity to accompany him on a trip through largely unknown territory was a temptation too great to be resisted. Consequently, we prepared a Ford for a week's run, and the next day set out for Fort Myers. Miami and Fort Myers are about 120 miles distant from each other, in a direct line, but the intervening area could have been conveniently, or at least expeditiously, traveled only in an aëroplane. The shortest course possible for us followed a curve more than 250 miles in length.

In order to bring us to our most distant objective which lay across the Everglades only about sixty miles from Miami, we had to make a detour around the Everglades and Lake Okeechobee at their head. The facilities for making an examination of the country and a collection of specimens of its vegetation were generously furnished by Mr. Charles Deering, of Miami.

The first stage of our course lay along the eastern coast of Florida between Miami and Fort Pierce. Miami, Fort Pierce, and Fort Myers are about equidistant one from the other, or, straight lines connecting the three places would form an equilateral triangle. The territory included in the triangle, made up mostly of everglades, prairies, cypress swamp, and pineland, together with Lake Okeechobee situated near one side of the triangle, was essentially uninhabited, except for the scattered settlements in the Caloosahatchee River region. Between Miami and Fort Pierce pinelands and sand dunes (scrub[2]) predominate; between Fort Pierce and Fort Myers are pinelands and prairies; while between Fort Myers and Miami lie prairies, cypress swamps, and the Everglades.

Mr. Hanson preceded us to West Palm Beach, where we overtook him. It was late in the evening when we reached Stuart, where we had to spend the night because of a high wind which made the ferryman hesitate to carry us across the Saint Lucie River. An early start the next morning brought us to Fort Pierce in time for breakfast. Thence we started on the second leg of the triangle, proceeding in a southwesterly direction.

Between Miami and Fort Pierce our course took us through not fewer than forty towns.[3] After leaving Fort Pierce only four settlements were encountered, two established settlements and two embryonic colonies.

After Fort Pierce disappeared from view we sped westward through pinelands and across the Halpatiokee Swamp, where countless turtles and snakes basked in the sun about the water pools that lined the road.

[1] *Journal of the New York Botanical Garden*, Vol. XIX, 1918, pp. 279–90. THE AMERICAN MUSEUM JOURNAL, Vol. XVIII, 1918, pp. 684–700.

[2] These are quiescent inland dunes of snow-white sand.

[3] These lie outside of the triangle of uninhabited territory referred to in a previous paragraph.

A TRANQUIL JUNGLE STREAM ON THE INDIAN PRAIRIE

Fisheating Creek, or, in less commonplace parlance, "Thlathtopopkahatchee," is still little known, because it runs through nearly uninhabited country. It rises as a drain for a greatly elongated (twenty five mile) slough which lies near or forms the western boundary of the southern extension of the lake region of Florida. The creek is almost equal in length to the slough it drains. It meanders through pine woods and through prairies, ultimately reaching Lake Okeechobee. Its banks are often hammock clad. Live oaks, sweet bays, and red maples predominate on the shores, and in some places conifers—pine or cypress—or cabbage trees replace the hammock. Occasionally long stretches of water are completely concealed by floating carpets of water hyacinth, and others, clear of all aquatic plants, sharply mirror the bordering vegetation

After crossing the swamp another stretch of sandy pine woods was traversed with difficulty, as the combined power of the engine and the pushing ability of the occupants of the car were necessary to get through the twelve miles of loose sand. Finally the Onoshohatchee River and the first habitation in about forty miles came into view. We soon reached Okeechobee City—then a settlement of several scores of houses. In the fall of 1913 when we went up the Onoshohatchee River from Lake Okeechobee this place had been indicated on the map and staked out by the surveyors, but had not yet been colonized.

At this point we again left civilization behind. From Okeechobee City to Fisheating Creek the country was devoid even of roads, and we took to an old trail dating back perhaps to a period before the Seminole wars. By degrees Okeechobee City disappeared as we hurried around the curves, not to say coils, in the trail, and after passing some miles of pinelands we suddenly came into the bottoms or prairies of the Kissimmee River. These bottom lands are like immense lawns, perfectly level, carpeted with a turf of various grasses, and often extending as far as the eye can see. There were thousands of semiwild cattle grazing on the broad green prairies.

All had gone well thus far, but at the Kissimmee River a series of apparently predestinated troubles began. The trails on either side of the river were connected by a ferry which consisted of a flatboat large enough to hold a car, and a small motor boat of barely sufficient capacity to drag the flatboat around the bends and over the sand bars in the river. In order to cross the river, which there is less than a hundred feet wide, it was necessary to go about a half mile down stream because of the erosion of the banks. Once in the stream the current of the river—say, three miles an hour—carried the ferryboat along at a greater speed than the motor boat could maintain. Time and again the ferryboat would bump into the river banks, first on one side, then on the other, and would, in turn, bump against the stern of the little motor boat and knock off the rudder. Even after the ferryboat drifted out of sight, we who were left behind for the second trip could hear the ferryman nailing the rudder on his disabled boat.

We lost several hours of valuable daylight while waiting for the ferryman to replace dead batteries with live ones. As the short twilight deepened we ran up a slight incline through a strip of pine woods, making all haste compatible with the innumerable curves in the trail and the proximity of pine stumps, and found ourselves on the great Indian Prairie. This comprises a large part of an immense region lying west of Lake Okeechobee, north of the Caloosahatchee River, and east of Peace River. The prairie is high and dry all the year round and is uninterrupted, except by a single stream, Fisheating Creek, one of the larger feeders of Okeechobee. Up to a short time ago it was practically uninhabited, except by wandering Indians. At the present time a half dozen or more "—ports," "—dales," "—monts," "—burgs," and even "—Cities" have been put on the map, and a railroad bisects the region,—so, farewell to its natural features.

In order to save time, we decided to cross the prairie that night, and we certainly had a weird ride. The trail at times was distinct, but at other times almost blind. Although the prairie was a dead level, the optical illusion created in the darkness was that of running down hill and jumping off the earth. We had some obstructions to progress in the form of forks in the trail which would, we knew, either come together farther on or diverge indefinitely and thus lead to some other part of the state. At each fork, the four in our party would hold a council, and in each instance consult the stars. The stars always put us on the right trail, and toward midnight, after passing several half-discerned Indian camps, we saw a few faint lights of human habitation appear, and finally we reached the recently established colony of Palmdale on Fisheating Creek, or, in Seminole, "Thlathtopopkahatchee."

We did not hesitate to disturb the peaceful slumbers of the inhabitants, who were as glad to see us as we were to see them, which fact they showed in a substantial manner by arising from their slumbers and preparing a midnight meal. After a few hours' rest we made an early start for Labelle, which is an old settlement situated at about the head of natural navigation on the Caloosahatchee River.

The Indian Prairie extends nearly or quite to the Caloosahatchee. Unfortunately, a road had been laid out to connect Palmdale with Labelle. It is well we decided to stop at Palmdale until daylight, for although we could travel the almost trackless prairie in the dark with ease, we could barely traverse this new road in broad daylight. The deep sand had become very loose, and it took more than the engine to get the cars over a good many miles of the road.

Just south of Palmdale we crossed Fisheating Creek, which is an exceedingly picturesque stream meandering through the almost uninhabited prairie, between banks either exposed to the sun, or clothed with shrubs and bright-colored asters or hammocks of oaks, ash, and maple, which in some places give way to groves of palmettos that often lean far over the water's edge. After leaving the hammocks which border the creek we drove out on the prairie again, and few trees came into view for a distance of about eighteen miles, until the hammocks bordering the Caloosahatchee appeared.

Perhaps the most interesting creature on these prairies was the burrowing owl. This bird had honeycombed the prairie in many places with its burrows. These tunnels, often six to eight feet long, are about a foot beneath the surface of the sand. At one end is an opening approximately six inches in diameter, while at the other end is a nest. The old owls were so tame that one could almost pick them up, and often they would sit perfectly quiet while the automobiles passed them at a distance of not more than two feet.[1]

On this same prairie many interesting plants were observed and collected. Milkweeds were represented by species of *Asclepias* and *Asclepiodora,* while more conspicuous was the purple water willow *(Dianthera crassifolia).* Low milkworts *(Polygala)* with white and yellow flowers were prominent in the landscape, and clumps of the native beardtongue (*Pentstemon multiflorus*) towered above all the other herbaceous plants. There a white-flowered heliotrope replaced the common yellow-flowered heliotrope of the region lying east of the Okeechobee basin and the Everglades.

After contending with the sand for several hours we reached the Caloosahatchee River and came to the town of Labelle, where we did not delay, but went directly up the Caloosahatchee several miles to Fort Thompson. There we found a number of magnificent live oaks around the old barracks which date from the period of the Seminole wars. After making a number of photographs in that region we returned to Labelle and at once started down the south bank of the Caloosahatchee River for Fort Myers.

We now left the prairies behind and entered the flatwoods, where the arboreous vegetation is made up almost entirely of pine trees. Peninsular Florida, especially the southern part, lacks what is ordinarily understood as altitudes, in fact, most of it is decidedly flat. It might well be called a large sand bar. Notwithstanding this disadvantage, it reveals an astonishing number of surprises in the matter of diversity. The Big Cypress is one of the larger surprises. Its area is about half that of the

[1] Out of curiosity we decided to dig into one of the burrows. Starting at the opening, we began by lifting the sand out very carefully. Of a sudden we were startled by the rattle of a rattlesnake. After proceeding a few inches farther we heard two rattlesnakes; before going much farther into the burrow a third rattlesnake began to rattle. The digging became more exciting as we worked farther in and as the snakes rattled more loudly. When we neared the end of the burrow we cautioned one another to be careful not to get our hands too close to the snakes.

This seemed to be an excellent opportunity to get good photographs of living rattlesnakes. Consequently the camera was set up and everything prepared for the opening of the end of the burrow. As there was no woody growth on the prairie the question of getting sticks with which to fight the snakes arose. After considerable search several surveyor's stakes were found, and with these we prepared nooses for capturing the serpents alive. With extreme caution we approached the end of the burrow; the snakes began to rattle more viciously. Finally the sand was removed from the top of the end of the burrow, and to our surprise we found four young owls, three large and one small, but—no snakes!

It was the three larger owls that were making the noise of a rattlesnake, and imitating it so well that all of us who had had personal experience with rattlesnakes were deceived. We decided that this experience proved that the stories we used to hear of owls, prairie dogs, and rattlesnakes living peacefully together in the same burrow were fantastic. Of course, a rattlesnake might enter an owl's burrow, either to seek shelter or food; but it is a difficult matter for any one well acquainted with the habits of rattlesnakes to believe that a husky rattler would be considerate and restrain his appetite, with such a tempting morsel as a young owl or young prairie dog lying about in his den. (For further notes on this subject see: *The American Naturalist,* Vol. XLI, pp. 725–726; Vol. XLIII, pp. 754–55; *Birds of the World,* pp. 536–37.) After photographing owls instead of rattlesnakes, we replaced them in their nest and rebuilt their burrow, as well as we could, by making a roof of brush over which we replaced the sand.

Palms and pine trees are often a favorite refuge for wild turkey and deer. A flock of turkeys took refuge in this particular grove just as we suddenly rounded a sharp curve in the trail. In the Big Cypress there may be prairies so extensive that woody vegetation can be seen merely as a dark line along the distant horizon, or again we may see at one time associations of palms and pines, pure pine woods, solid broad-leaved hammocks, cypress heads, and combinations of cypress head and hammock

Everglades, and although it abuts directly on the western side of them, it has but little in common with them. Instead of being a vast prairie-marsh like the Everglades, the Big Cypress exhibits a variety of conditions and plant associations. There are pinelands, prairie, sloughs, cypress heads, hardwood hammocks, palmetto hammocks, and lakes.

Early in the afternoon we were prepared to strike into the wilderness. After leaving Fort Myers, roads disappeared and we took to mere trails through the pine woods in a southeasterly direction. As we proceeded, strange plants and strange birds began to appear. White terrestrial orchids (*Gymnadeniopsis nivea*) and single-flowered spider lilies (*Hymenocallis humilis*) dotted the dry prairies, while uliginous creepers with various colored flowers formed encircling mats about all the shallow ponds. Ponds and pools were the favorite feeding places for the wood ibis, the white ibis, cranes, and herons. The hammocks hid many flocks of wild turkeys in their depths.

For some distance outside of Fort Myers we traveled through unbroken pine woods. As we went on, the pine trees became more scattered and areas of prairie came into view. Farther on, the prairie began to increase and the pines appeared only here and there as isolated colonies. A little farther on cypress trees appeared, and we were really in the Big Cypress. Here, too, the cabbage palm was much in evidence, and in some places it formed hammocks of almost pure growth. As we proceeded, the prairies grew larger and the cypress grew less, until there was open prairie in all directions almost as far as the eye could see. Then the hammocks clothing the Okaloacoochee Slough appeared in the distance as a mere line on the horizon. It is said that the Seminole word "Okaloacoochee" signifies "boggy-slough." Consequently the usually associated word "slough" is really superfluous.

As we approached the slough we observed immense flocks of ibis collecting at their rookery for the night. The confused sounds they made as they flew over the tops of the tall trees could be heard for a distance of a mile. The sight of the great flocks of ibis and the racket of their croaks or squawks as they collected in their rookery we shall long remember.

We drove into a small hammock within half a mile of the slough and prepared to camp there for the night. Many interesting plants were collected on the prairies near the slough before darkness drove us back to camp. Indian plantains (*Mesadenia*), foxgloves (*Agalinis*), and heliotropes (*Heliotropium*) grew nearly everywhere. Fully as interesting as the native plants was the climbing black-eyed Susan (*Thunbergia alata*), which we found extensively naturalized on the prairie near the Okaloacoochee. The plants now growing there may be the descendants of specimens introduced and cultivated in gardens the Seminoles maintained there fully a century ago.

The following morning we broke camp about daybreak and proceeded to cross the slough. We parked our cars in its midst on the very spot where, it is said, more than sixty years ago Lieutenant Harsuff's company of engineers had their sanguinary clash with Chief Billy Bowlegs—after they had destroyed the old chief's garden just to "see old Billy cut up."

The larger trees of this hammock consist of the bald cypress or river cypress (*Taxodium distichum*). It was a favorite spot for the Indians to obtain logs for making their dugout canoes. In the rainy season there is commonly about six feet of water in the slough. After the rainy season the water table is naturally lowered by seepage. The waters, evidently, find their way directly into the Everglade basin, and directly or indirectly into the Gulf of Mexico. In the dry season most of the slough can be traversed on foot. It was the custom of the Indians to go to the slough in the dry season, cut down the trees they selected for making the canoes, and then wait for the wet season and high water to float the logs out toward the western coast.

We went down the slough afoot just as the thousands of birds in the rookery were awakening. The birds mostly represented several species of ibis, and were present by the hundreds and thousands on the large cypress trees. In fact, they were so crowded on some of the giant cypresses that they were continually falling off for want of sufficient room to stand. As a consequence of not having been much disturbed by man, they were so tame that one could walk

In the Okaloacoochee Slough dead trees as well as living serve as part of the ibis rookery, for the birds are so numerous that any available space is used. Their nests are rude cradles of sticks in the trees or on ledges of rock. During the day the birds leave the rookery, traveling in more or less definite groups or companies. This photograph was taken in the morning, after the greater number of the birds had departed

A NATURAL AMBUSCADE

From such beautiful coverts—perhaps from this very spot—commands of the United States Army fought the Indians during the Seminole wars. A riotous growth of shrubs whose stems are intertwined with woody vines form an almost impenetrable thicket extending back to a wood of river cypress in the lower part of the slough. The hammock floor is a mass of ferns and small herbs; Boston and sword ferns in particular are prevalent. There are at least fifty other kinds of ferns—many of them epiphytic—which display the greatest possible variety in structure and contour toward them, set up a camera, and photograph them at short range.

There was water in the lower parts of the slough, but none was visible, for the surface was completely covered with a soft carpet of various small aquatics. These were distributed in patches of beautiful shades of green. In the higher parts of the slough ferns and flowering plants grew in about equal profusion and remarkable luxuriance. The growth reminded me of that in the hammocks of the eastern shore of Lake Okeechobee.[1] The large, straplike leaves of the spider lily and the paddle-like leaves of the golden club or bog torches (*Orontium*) were very conspicuous. The leaves of the golden club here at its most southern known station were fully three feet long, while the fruiting spadices lying around on the ground were thrice the size of any that I have ever observed at the north. The lizard's-tail (*Saururus*) was also there in great abundance.

Thus these typically northern plants, the lizard's-tail and golden club, are there intimately associated with such typically southern plants as the water hyacinth and the water lettuce. Other southern elements represented are the Boston fern (*Nephrolepis exaltata*) and the wild coffee (*Psychotria undata*).

After making a collection of all the plants observed and photographing the more interesting views, we returned to our cars, crossed the slough, and set out over the prairie in the direction of Rocky Lake, which lies in an uncharted spot in the Big Cypress between the Okaloacoochee Slough and the Everglades. As we proceeded, palmetto hammocks, hardwood hammocks, and cypress heads became more numerous on the prairie. At last we came to the hammock surrounding Rocky Lake, which is known to the Seminoles as Okee-hy-yot-lochee, a word said to mean "wide-open-water," where we camped for lunch, and made collections of the plants. This lake is contained in a rock basin several acres in extent. It is said that it is fully seventy-five feet deep, and abounds in fish and alligators. Of course, it would be somewhat of an exaggeration to say that one could walk across the lake on the alligators' backs; but they were more numerous than I have ever seen them elsewhere.

After lunch we set out for the ruins of an Indian mission[2] which some years before had been established near the site of the one-time Fort Shackleford, and then abandoned. After leaving Rocky Lake the trail wound in and out between hammocks and cypress heads until finally more open prairie was reached.

When we arrived at the Seminole mission we were now not more than four miles from the western edge of the Everglades. A unique specimen of the cabbage tree was observed—a five-fingered object, with five branches of about equal length arising from the trunk, just above the surface of the ground and all in one plane. Probably nowhere is this duplicated. Many interesting plants were found in the vicinity, especially several loosestrifes (*Lythrum*), and a false indigo (*Amorpha*) which is apparently different from any known species.

[1] See *Journal of the New York Botanical Garden*, Vol. XV, pp. 69–79; Vol. XIX, pp. 279–290. The AMERICAN MUSEUM JOURNAL, Vol. XVIII, pp. 684–700.

[2] The old Seminole mission thirty-five miles beyond Immokalee was established about 1910–11 through the instrumentality of William Crane Gray, then Bishop of southern Florida, for the Protestant Episcopal Church, the work being undertaken by Dr. William J. Godden, of Greenwich, England, who happened then to be touring the United States. Dr. Godden, a man of high connections and attainments, soon won the love of both red and white men. Originally, he started a small hospital and social center for the Seminoles at a point about seventy miles back from Fort Myers, near the historic site of old Fort Shackleford. He called this first settlement Glade Cross—because of its proximity to the Everglades and the large white cross he mounted against a cabbage palm. But when a couple of red patients died in the hospital no more Seminoles could be induced to come near the place. The mission was thereupon transferred to the lonely outpost called Boat Landing, on the edge of the Everglades, at that time the head of all the canoe trails of the region. It was not long, though, before the partial drainage of the Everglades dried the canoe trails, and Boat Landing ceased to be a port of call, or any port at all. So the doctor once more moved his mission, this time to about the center of the present Seminole Reservation, five or six miles from his former locations, right in the heart of the Big Cypress, where he hoped to establish an experimental farm. He put up a number of buildings—a store, a dispensary, various shelters. He employed the Seminoles to dig a couple of miles of drainage ditches about the place. He himself worked far harder than any-one else—without pay, mostly alone, always devoted, perfectly kind—while his people in England urged him to return to them. He died at the mission, suddenly, presumably of heart failure, in 1911. And now Glade Cross is jungle again; only a few broken canoes mark the site of Boat Landing; and the last site of all, still called "Godden's Mission," is merely a weedy, haunted ruin. The doctor's body was buried at Immokalee, a Seminole word which signifies "My Home."—Perley Poore Sheehan.

YOUNG OWLS AT THE FAR END OF A BURROW IN THE SAND

We sometimes find in the sand of the prairie a hole about six inches in diameter—the entrance to the home of the burrowing owls. Such holes occur in "towns" of from three to twelve or more; some parts of the prairie are so honeycombed with burrows that we marvel how they and the nests in them are preserved from destruction during heavy rains. The nest is built about six or eight feet from the opening of the burrow and commonly is only six or eight inches beneath the surface. The parent owls are rather tame and may be approached within a few feet, but the young birds are vicious in appearance, voice, and manner—at least when disturbed. How could anyone ever have believed that a rattlesnake and such tempting morsels of food as these young owls would be likely to live long in peace within the same burrow

A FLOATING MEADOW OF FLOWERS

The water hyacinth (which completely covers the water in this tributary of the Caloosahatchee) always improves the landscape, and usually is not the impediment to navigation that it has the reputation of being. Moreover, the more or less extensive areas of bright blue flowers set above the deep green leaves are unique in our flora. Live oaks, laurel oaks, and water hickories line the banks of this stream, and the long growths of Florida moss reach from the spreading limbs of the trees to the water

A GIANT TREE OF THE FLORIDA "BIG CYPRESS"

The brilliant green of the river cypress, which largely forests the sloughs, is intensified by contrast with the waving grayish white streamers of Florida moss and the gay pink and white plumage of the nesting ibis. In the widespreading limbs of the giant trees hundreds of the birds roost and when they rise in their powerful flight the sun burnishes their outstretched wings with a metallic sheen that adds a further touch of the picturesque to the landscape. The birds covered the top of this tree when it was photographed, outlining it against the sky, but their colors on the light background failed to impress the photographic plate

NATURE GIVES THEM A FORMAL ARRANGEMENT

Relatively slender and narrow-branched trunks are characteristic of the pond cypress so that it is not adapted to support rookeries. It harbors great quantities of air plants and, although it does not bear a copious growth of Florida moss, several other species of *Tillandsia* cling to its branches,—often through the accumulation of generations the plants form masses out of all proportion to the size of the tree. Pond cypresses are usually evenly spaced as if following an architectural plan, whether they are distant from one another, as here shown, or set so closely together that passage between their trunks is difficult

Wild orange trees, some with sour fruits, others with sweet, occur in the hammocks of the Big Cypress. Of course, some of these are the remnants of trees planted by the Seminoles; but others may be derived from ancestors planted there by the aborigines of that region or by the Spanish adventurers themselves.

The cypress of the region outside of the large sloughs was the pond cypress (*Taxodium ascendens*). The prairies were showy flower gardens. Several species of *Polygala*, several of *Sabbatia*, three or four kinds of terrestrial orchids, and a number of other conspicuous plants, both monocotyledons and dicotyledons, often covered acres in extent. A yellow-flowered bladderwort grew copiously in extensive patches in the dry white sand! Many rare and little-known plants were collected for future study.

Rocky Lake proved to be the lunch station. While in a temporary camp near the shore the writer rescued two animals from living graves. On two different occasions, while going to the lake for a drink of water, he was startled by agonizing cries. In the first instance, a large water moccasin had caught a mocking bird and was attempting to swallow it. In the second instance, another moccasin had caught a frog which he was trying to slip down his throat. In each case the victim went free and, it is to be hoped, survived.

After recrossing the Okaloacoochee Slough, instead of retracing our former course we turned more to the westward and headed for the colony of Immokalee. After passing through stretches of forest and prairie we came in view of the scattered houses of the settlement. This colony, situated about thirty miles in a direct line from Fort Myers, comprises a general store and a few dwelling houses. We reached Fort Myers shortly after sunset, and early the following morning started up the Caloosahatchee River by the same course we had taken several days before. Numerous stops were made along the way for collecting plants and taking photographs. Palmdale, where we took the trail over the great Indian Prairie, was reached early in the afternoon. The herbaceous vegetation and magnificent palmetto hammocks not visible in the dark gave an entirely different impression of the prairie region. Some of the same genera of plants were common to both the Indian Prairie and the Big Cypress but the species were usually different. The Caloosahatchee River is evidently a natural boundary between different floral regions. The most striking feature in the vegetation of this prairie, however, is the cabbage tree. This palm grows in small clumps and also forms hammocks from one to many acres in extent, surpassing in luxuriance any growth of it I had seen previously.

After the usual bumping of banks and sand bars the ferry landed us on the opposite shore of the Kissimmee River whence we at once set out over a trail which seemed to have endless windings, but which finally brought us to Okeechobee City. From there, after a night's rest, we journeyed to Fort Pierce, collecting as we found favorable places in the pine woods and in the swamps, and next day we started on the final stage of our return trip to Miami. The city was reached without further incident, except the passing survey of a large hammock on a high sand dune along Saint Lucie Sound or Lower Indian River, which has already been partly described[1] and which has been designated for thorough exploration.

This preliminary survey deeply impressed upon us the wonderful natural history of that little-known region. Our time was limited and the region was large, but some day, before drainage and other depredations of civilization, not to mention vandalism, have removed the bloom from that still unspoiled garden, we hope to make another and longer visit to the land of the Big Cypress.

[1] *Journal of the New York Botanical Garden*, Vol. XIX, pp. 76–77.

The Gypsy Moth in New Jersey

THE gypsy moth (*Porthetria dispar*) entered America in 1868, and it has been one of the most troublesome of insect pests ever since, but by great effort and the expenditure of millions of dollars it has been confined to the New England States. Now, however, it has invaded New Jersey. This invasion probably started about 1911 through the introduction of blue spruces imported from Holland for the James B. Duke estate at Somerville (about 2300 acres extensively planted to evergreens and ornamental shrubs). At that time there was virtually no government inspection system in force and the pest probably came in at the docks without being noted.

The infested area now covers about one hundred square miles of territory with Somerville as the center. In addition the insect has been located at Deal Beach, South Orange, Paterson, Ridgewood, and Madison, New Jersey, and also at Loretto, Pennsylvania. These infestations owed their origin to trees shipped from the Duke estate. All of the stock that has ever been sent out from this estate is being traced and inspected by federal men.

The New Jersey State Department of Agriculture is planning to ask an immediate appropriation to be used in fighting the pest. The entire northern part of New Jersey with its valuable estates and ornamental plantings is threatened. The insect attacks especially shade and forest trees, although it feeds also on the trees of the orchard. Indeed, the destructive ability of the nocturnal young caterpillars may be judged from the fact that they feed on more than five hundred species of plants. If it were an insect that attacked agricultural crops, each farmer might be able to save his own acreage, but the protection of shade trees and forest areas must rest with state and federal governments.

New England is spending $1,000,000 every year just to hold this insect in check within its boundaries. If the gypsy moth is allowed to spread in New Jersey, it is only a question of time before it will be in New York and neighboring states which have unusually large forest interests. Evergreens, when once their foliage is lost, are killed for all time, and deciduous trees, if defoliated more than two or three years in succession, usually die also.

It will probably require from three to five years before we can say with any degree of certainty that the gypsy-moth pest in New Jersey has been cleaned up. The whole territory will have to be scouted again and again to be sure that nothing has been missed. It is greatly to be hoped that the plague has not found entrance to the forests of Watchung Mountains just outside of Somerville. If it is there, the work will take more time and effort because of the difficulty of spraying trees on the mountainside.—H. B. WEISS, Chief of the Bureau of Statistics and Inspection, New Jersey State Department of Agriculture.

Foreign Insects Newly Come to America[1]

A SMALL member of the Lepidoptera, a pyralid moth (*Pyrausta nubilalis*), has recently found its way to this country from Europe, probably in a shipment of broom corn from Austria-Hungary, and some of our best economic entomologists fear that it may become a very serious pest. It was discovered in 1919 infesting corn in the vicinity of Boston. The insect has only one brood a year in some places, but in others not only do adults appear in May from larvæ that have overwintered in old stalks, but there is another generation in midsummer. The larvæ bore their way into the tassel stalk, causing it to break, or into the main stem, lowering the vitality of the plant, or into the ear, spoiling it for food. *Pyrausta* breeds, also, in a great variety of weeds which makes it more difficult to control.

Another newly introduced pest is the "green Japanese beetle" (*Popillia japonica*) which skeletonizes the leaves of various trees and hardy shrubs. It is a small scarabæid that was discovered in 1916 in Burlington County, New Jersey, but a recent bulletin states that in 1919 it had increased to such an extent that 20,000 beetles could "be col-

[1] For fuller details of these and other insects common in the northeastern United States see the 1921 edition of *Field Book of Insects*. G. P. Putnam's Sons.

lected by hand by one person in a single day." The first beetles probably came in with earth surrounding the roots of some ornamental plant such as iris or azalea.

Among the foreign insects which have entered American ranks, spreading beyond their point of entry, it is pleasant to record one which is not injurious. This is *Calosoma sycophanta*, well named "caterpillar hunter," a European beetle which was introduced near Boston some years ago to help in the control of the brown-tail moth. It is now well represented in the vicinity of New York City.

On the other hand, practically every one of the insects that are seriously injurious to our crops in America are introduced species. I do not recall now a single native insect that is a decided plague. The Hessian fly and the cabbage butterfly, for instance, are both introduced species.

Our native insects have been here a long time and have already spread as far as they are going to. Foreign insects, however, which have just come in will spread until they have reached a distributional limit. That they multiply so rapidly and can spread with such alarming speed is explained in part by the fact that the parasites which preyed upon them in their old homes were not introduced with them. Our economic entomologists are importing these enemies of the foreign insects as the most feasible method of control.—FRANK E. LUTZ, Associate Curator of Insects, American Museum.

A Case in Point to Prove the Value of Prolonged Research

THE facts are being set forth, by Samuel J. Record, professor of forest products and expert on wood identification at Yale University, of a wonderful achievement in lumber drying. Mr. Harry Donald Tiemann, dry kiln specialist of the Government Forest Products Laboratory at Madison, Wisconsin, has revolutionized the industry[1] and he did it at just the psychological moment in the history of lumber drying in the United States. This was when we entered the World War and the demand became immediate for vast amounts of *dry* lumber for the various implements of war. Lumber manufacturers had no quick method for drying oak, hickory, and walnut, the woods especially needed. The customary method often required four or five years—merely to expose the timbers in protected piles. Dry kilns were used only for shingles and other thin specimens or for the softer woods.

Fortunately for the situation, one man in the country had been spending years of research on this very problem, namely, the behavior of wood relative to its moisture content. He had experimented during six years at Yale Forest School, using testing machines and compiling results gained from crushing and breaking wood under all conditions of moisture—green, water-soaked, kiln-dried, air-dried, boiled, and steamed. He had continued his experimental work at the Forest Products Laboratory, of the University of Wisconsin, from 1909 to the opening of the war. Here he had been able to use experimental kilns in which temperature and humidity were under measured control, as well as circulation of air. He finally evolved from his long series of experiments a process by which the drying is accomplished through regulation of the humidity in the kilns—the kilns being especially devised drying chambers of his own invention, but of such character that they can be developed without great difficulty from the manufacturer's ordinary kilns.

There could be no more powerful specific proof of the value of prolonged scientific research and experiment, whether within an industry or under the auspices of the government or in an academic institution. These kilns invented by Mr. Tiemann allowed drying the most refractory kinds of lumber in limited periods of time and with no loss of either strength or elasticity of the wood. Oak for wheel stocks was perfectly seasoned in three months instead of from three to five years; black walnut was dried for army rifles in two months; and aëroplane stock was prepared in one month. It is not easy to estimate or properly appreciate the value to the nation of so vast a service.—THE EDITOR.

[1] I quote from a letter from Professor Record: "What I have attempted to do is to lift the veil of anonymity that shrouds government employment and reveal the great work of an individual. Of course others and the organization have helped in the practical application but the basic fact and theories were worked out through years of concentration on the part of Mr. Tiemann."

Notes

Owing to unavoidable delays in the preparation of Natural History it has been necessary to omit the July-August number, and the present issue for September-October, containing an increased number of pages and illustrations, takes its place.

Sir Norman Lockyer, for fifty years editor of *Nature* and one of the leading astrophysicists of the world, died on August 16. Sir Norman was one of the pioneers in the application of spectroscopy to astronomy. He was the first to observe the solar prominences at times other than during an eclipse, discovering in the course of this study the element helium twenty-seven years before it was isolated on the earth. He was director of the British Solar Physics Observatory from 1885 to 1913. Later he devoted himself to erecting an observatory and station at Sidmouth, where he spent the last years of his life. Not only in pure science but also in public activities was Sir Norman a leading figure in England. He was among the first to impress the British government as to the value of science to the army and navy; he led in the founding of the British Science Guild, which remains as an institution for stimulating the application of science; and it was indirectly owing to his clear presentation of the needs of the nation that the government made large grants to the universities for scientific research.

Word has recently reached the American Museum of the death in 1916, in the Fayûm, of Richard Markgraf, the veteran collector of Egyptian fossils. Mr. Markgraf was an Austrian by birth and, in his earlier years, a professional musician. While in the prime of life, serious pulmonary trouble made it necessary for him to leave the humidity of Europe and so he moved across the Mediterranean to Egypt, where the wonderful arid climate enabled him to continue life in moderate comfort for twenty years or more. Here he took up natural history collecting as a means of livelihood, and after the discovery by the Egyptian Survey, about the year 1900, of the remarkable ancient mammal fauna in the desert sands along the edge of the Fayûm depression, he directed his efforts to the search for these fossils, working during the cooler months of the year with a small caravan of two or three camels and a native assistant. In this work he was employed principally by Professor Eberhard Fraas, of the Stuttgart Museum, and the extensive collections sent by Markgraf to that institution have since been the subject of elaborate memoirs by German palæontologists. The American Museum's expedition to the Fayûm in 1907, under the leadership of President Henry Fairfield Osborn, was visited in its desert camp by Markgraf, who was at that time unemployed. His services were immediately engaged, and he carried on, with his own equipment, exploration work in that vicinity for several months. After the return of the expedition to America he was employed at intervals over a period of two or three years for short trips into the desert, always with success. As a total result of this work our Fayûm collection has been greatly increased and several of the choicest specimens of the American Museum are credited to him.

The hundredth anniversary of the birth of Andrew Haskell Green was celebrated on October 6 in New York City. He was at one time president of the Board of Education and comptroller of the city, and was closely associated in the last named capacity with the founding of the American Museum. In 1869 Mr. Green was elected a trustee of the American Museum and was appointed a member of its executive committee, on which he served until 1881. He was active not only in promoting the increasing usefulness and popularity of the institution, but also in the encouragement of research.

We record the death of Mr. Frank Slater Daggett, director of the Museum of History, Science, and Art, of Los Angeles. Mr. Daggett spent the greater part of his life in commercial pursuits in Minnesota and Illinois. In 1911 he entered on a professional scientific career when he assumed the directorship of the newly founded museum in Los Angeles. Here he supervised the collection of important exhibits representing the natural history of southern California, and exploited scientifically the now famous asphalt deposits at Rancho-la-Brea.

Baron Gerard de Geer, professor of geology in the University of Stockholm, and Mrs. de Geer, together with Dr. R. Lidén and Docent E. Antevs, visited the American Museum on August 20. The party has come to this country to study the geological chronology since the Glacial period. Professor de Geer has worked out and applied in Europe a method of counting the seasons by the laminated clay layers annually deposited by the glaciers during the melting seasons.

The record enrollment in the United States for students of geology is announced by the University of Oklahoma. There are this year one thousand students in the department, which maintains a staff of four associate and thirteen assistant professors in addition to the head of the department. Microscopic work is being offered for the first time this year, including a special study of cuttings from oil wells provided from the Healdton, Oklahoma, oil field, through the courtesy of the Roxanna Oil Company.

An account of the drilling of our deepest wells in recent years and some of the scientific problems which they help to solve is told by Mr. Robert G. Skerrett in the *Scientific American*. The drilling of the deepest well in the world was interrupted by a cave-in far down in the hole after a depth of 7579 feet had been reached. This well, called the Lake well, was sunk in West Virginia in 1919, with the hope of reaching an oil-bearing strata of sand at 8000 feet. The second deepest well, the Goff well, is also in West Virginia, and reached 7386 feet before it was discontinued in 1918 because of the breaking of a cable; the third deepest well in the United States, the Geary well in Pennsylvania, was crushed in at 7248 feet by a water pressure of nearly 3000 pounds to the square inch. Although the boring of all these wells had to stop a few hundred feet short of the objective, it revealed a number of geologic facts of importance. The Geary well, in particular, penetrated layer after layer of rock salt below 6800 feet, showing that these strata extend in sheets of many thousand square miles as "the remains of fossil ocean water imprisoned in mid-Palæozoic time"—which may contain valuable deposits of potash salts so important for agriculture. The United States Geological Survey has investigated the problem of subterranean temperatures with specially designed apparatus in all three of these wells, recording a temperature of 168.6 degrees Fahrenheit at 7500 feet in the Lake well.

Two very important aids to the use of scientific literature on South America have recently appeared, the one a bibliography of the mineralogy and geology of Chile, the other a bibliography of the geology, mineralogy, and palæontology of the republic of Argentine.[1]

A number of minerals, of which chalcedony is the most common, have been found replacing wood, as in the noted petrified forest of Arizona. Replacement by dolomite, a common limestone mineral, has now for the first time been described[2] in a specimen from Kern County, California.

Dr. Amadeus W. Grabau, formerly professor of palæontology in Columbia University, has been appointed to a chair at the University of Peking. He will also serve as a member of the Chinese Geological Survey.

Dr. W. D. Matthew, curator of vertebrate palæontology in the American Museum, in a discussion[3] relative to discoveries of fossil vertebrates in the West Indies and the bearing of these on the origin of the Antillean fauna, concludes that the islands are not remnants of a former continent, nor have they in any likelihood been connected at any time with either of the American continents. The geologic evidence, as well as the submarine topography, is not favorable to either idea; the geology positively forbids a former connection with Florida. The islands are not very old geologically and have been built up by uplifting blocks and volcanic action. The fauna is very in-

[1] J. Brüggen, Bibliografía minera y jeolójica de Chile. *Boletin mineralógicas de la Sociedad de Mineria*, Santiago de Chile, Vol. XXXI, 1919, pp. 441–513, 539–607; Enrique Sparn, *Bibliografia de la Geologia Mineralogia y Paleontologia de la Republica Argentina*, 1900–14, Academia National de Ciencias Miscelanea: No. 2, Cordoba, 1920.

[2] *Journal of Geology*, Vol. XVIII, 1920, p. 356. By Mr. S. F. Adams, of Stanford University.

[3] *Proc. Amer. Philos. Soc.*, Vol. LVIII, 1919, p. 161.

complete and entirely insular in character and not the result of invasion from either North or South America over a supposed "land bridge." On the contrary the fauna must have arisen as the result of colonization through storms and ocean drift.

THE Bureau of Biological Survey at Washington, D. C., will in the future conduct the bird banding formerly carried on by the American Bird Banding Association under the auspices of the Linnaean Society of New York. This enterprise of placing identification bands on both water and land birds has already proved very instructive and when carried out on a large scale should give valuable information with reference to migration routes, speed, longevity, affinity for nesting sites, and behavior in general. The coöperation of volunteers throughout the country is earnestly solicited.

MR. ELIHU ROOT, speaking at this Fiftieth Anniversary Celebration of the Metropolitan Museum, expressed what civilization has long accepted as true, that the cultivation of taste is one of the mightiest agencies in the conflict between the discontent and tedium of life and happiness. We should add to this the practical dictum of Mr. Frederick Lee Ackerman, of Trowbridge and Ackerman, New York architects, who recently contributed an article to a symposium on education and art in the *Bulletin of the Metropolitan Museum*, that a true appreciation of art comes to very few except as a result of some creative experience. One key, then, to uplifting the spirit and refining the point of view of the laboring classes and advancing the happiness of all members of the race, would seem to lie in giving every student before he enters the period of self-support enough training through individual practice to provide him with an avocation in some line of art. Is it true that we must become a race of amateur artists before we can have any great output in art, any country-wide appreciation and devotion to art, or any large number of artists of the highest rank?

THE problem of opening the world's literature to the blind appears to have been finally solved through an invention by Dr. E. E. Fournier d'Albe[1] which has been constructed in a practical and commercial form by Dr. Archibald Barr, instrument maker of Glasgow. The translation of optical into acoustic effects is by way of an electric current through the metal, selenium, whose conductivity varies with the incident light intensity. An ordinary telephone receiver is attached in the selenium circuit. Luminous dots of different musical frequencies are flashed on to the printed line, letter by letter. Those dots which fall on white paper are reflected back while those which fall on the black of the type are absorbed. Each letter accordingly blots out certain notes and gives a characteristic chord while all the chords together constitute a sound alphabet which may readily be learned by most persons in a short time. The instrument as perfected by Dr. Barr can be adjusted to any ordinary printed type.

MR. JOHN BARRETT, director-general of the Pan American Union since 1907, retired from this post on September 1. He is succeeded by Dr. L. S. Rowe, formerly chief of the division of Latin American affairs of the State Department.

COLONEL W. B. GREELEY, chief of the Forest Service, returned early in September from Alaska, where he made an inspection of the Tongass National Forest. Colonel Greeley reported that the national forests of Alaska were able to supply a million and a half tons of wood pulp yearly and still keep the cut within the annual increase. The Tongass region alone can perpetually supply one half of the present news-print requirement of the United States. The government, by limiting this cut to an amount not exceeding the natural increase, will make the supply of pulp wood permanent so that manufacturers interested in the Alaskan field can count on raw material.

THE United States Forest Products Laboratory at Madison, Wisconsin, held its Decennial Celebration on July 22–23. Representatives from every wood-using industry were present. Dr. Carlisle P. Winslow, director of the laboratory, delivered an

[1] E. E. Fournier d'Albe, "The Type reading Optophone." *Nature*, Vol. XCIV, 1914, p. 4, and "The Optophone: An Instrument for Reading by the Ear." *ibidem*, Vol. CV, 1920, p. 259.

address at the banquet in which he quoted many of the results of the work of the laboratory. Investigation on the mechanical properties of woods has permitted a 20 per cent increase in allowable working stresses in structural timbers; experiments on the proper nailing of boxes have given results which will prevent damage to commodities in shipment; experiments on water-resistant glues and plywood for airplanes saved $6,000,000 in a year for the War Department alone; investigations on the uses of hull fiber and second cut cotton linters for pulp and paper have resulted in the establishment of plants with daily capacity of 300 tons; studies in methods of turpentining have resulted in increased yields. These are only a few of the problems upon which the laboratory has been working—and, in addition, a vast field lies as yet untouched.

THE point is taken in an article in the current number of *American Forestry*, by Mr. George W. Sisson, Jr., president of the American Pulp and Paper Association, that the immediate problem in the paper and pulp question does not so much concern discovering a supply in some remote part of the continent as in promoting a supply by protection and reforestation in localities where the old established industries may be served—as in the northeastern United States. He advises as necessary, whatever policy be followed, a continent-wide coöperation looking toward economy in the use of paper among all publishers and large consumers of paper or paper products.

THE reduction of the appropriation for forest investigation by $28,728 in the Agricultural Bill which has passed Congress is nothing less than a calamity. Experiments in forestry are not matters of an hour, but require decades for completion, so that this cutting off of financial support from the Forest Service for experimentation will effect in many instances the abandonment of research work carried on for the last ten or fifteen years. The reduction will close three of the four Forest Service Experiment Stations which are located at Priest River, Idaho, at Colorado Springs, Colorado, at Flagstaff, Arizona, and at Stabler, Washington. Such a curtailment can by no means be urged on the basis of economy, for forest investigations have resulted in great saving of lumber and increase of revenue from the national domain which have repaid many times over the cost of maintenance of the stations. It will be noted that this bill carries the usual appropriation of $239,000 for the distribution of free seeds by Congressmen.

THE forest depletion of the United States and possible remedial measures are summarized in a recent circular of the Department of Agriculture.[1] More than two thirds of the primeval forests of the United States have been cut or burned over and three fifths of the timber originally in the country is gone. At present about 26 billion cubic feet are cut from the forests annually and only 6 billion grown again. This is not use of forests but their devastation. Correction of the situation can come only through restocking the 326 million acres of cut-over timber lands now standing idle. This program requires a national forest policy on a much greater scale than at present exists and also active coöperation by the several states.

Ecology, the official organ of the Ecological Society of America, calls attention to the fact that the preservation of natural areas for scientific study is of incalculable importance. One of the best ways for accomplishing this, it points out, is through coöperation with those organizations especially working for the conservation of particular regions, such as the Okefinokee Society and the Save the Redwoods League.

AN addition of 130 acres of giant Sequoias to the Roosevelt National Park has been presented to the United States Government by the National Geographic Society. When the park was established in 1916 the society supplemented the original Congressional appropriation by a gift of $20,000.

THE National Geographic Society has engaged Mr. William L. Finley, formerly state biologist of Oregon, to obtain motion pictures of the rare birds and mammals of the North American continent.

DR. E. W. NELSON, chief of the Biological Survey, has spent several months recently in

[1] "Timber Depletion and the Answer." *Department Circular* 112, United States Department of Agriculture, 1920.

Alaska for a study of fur-bearing animals and of the salmon industry. Improvement of the reindeer herds as a source of meat, fox farming, and the protection of the land fur-bearing animals have been assigned to the United States Department of Agriculture, and a permanent staff for these duties will be established in Alaska.

THE *Statement of the Permanent Wild Life Protection Fund* for 1917, 1918, and 1919, has been issued by Dr. William T. Hornaday, director of the New York Zoölogical Park and campaigning trustee of the fund. The volume includes a special collection of illustrated campaign reports and papers on various features of conservation. This permanent fund, founded by gifts from Mrs. Russell Sage and other public-spirited persons, has now extended its activities beyond the shores of North America, especially into France and Belgium, where it has been engaged in promoting the protection of food crops. The chief activities in North America, other than the campaign for protection of the grouse, have been the promotion of legislation such as the game sanctuary bill and the migratory bird treaty, aid in the creation of 6468 wild life sanctuaries, contribution to game utilization in Canada, and opposition to the sale of seized plumage.

A LARGE shipment of animals from Africa has arrived in the United States and has been distributed among the New York, Philadelphia, and National zoölogical parks. The safe arrival of the shipment was made possible largely through the energetic coöperation of the director of the National Zoölogical Garden of South Africa at Pretoria, Mr. A. K. Haagner, who personally

By courtesy of the New York Zoölogical Society

This Bhutan takin (*Budorcas taxicolor*), for ten years past a resident of the London Zoölogical Garden, was a representative of the most southern of the three known species of this genus of Asiatic ruminants. Toward the South the species become successively darker in color and shorter-haired; that inhabiting Assam Valley, India, and Bhutan is chocolate-brown with black underparts; the Chinese takin discovered by Mr. Anderson in the Province of Shensi, central China (see page 428), is of uniform golden yellow; the Tibetan takin of Szechwan, southwestern China, shows an intermediate hue. The animals are about the size of our domestic cattle and are heavily built, yet they range over the rocky sides of high mountains with unusual nimbleness. In climbing precipitous slopes they are possibly aided by the two false hoofs of each foot, which are apparently functional brought the collection to America. The most valuable specimen is a Nubian giraffe, ten feet high. Among the other species of large mammals are included the nearly extinct mountain zebra, sable and lechwe antelopes, gemsbok, eland, gnu, springbok, blesbok, and Chapman zebra. Three individuals of a new species of Rhodesian baboon were the special gift of Mr. Haagner. In return, the New York and Philadelphia zoölogical parks are planning to ship to Africa a representative collection of American animals.

In a recent illustrated pamphlet[1] by Mr. Ned Dearborn, of the United States Biological Survey, a definite stand is taken for the protection of the North American small mammal fauna, outside of the recognized pests, rabbits, rats, and mice. Fortunately, the advice given is likely to be followed the country over because of the enhanced market value of all kinds of fur. The different species in themselves are for the most part valuable because they help rid the country of insect and rodent pests, or, if vegetable feeders, are at least negative in effect because not feeding on cultivated crops—and as fur bearers they put "millions of dollars a year into the pockets" of the Americans who trap them.

The species considered in the pamphlet, with statement of food, the best season for trapping, directions for construction of traps, and for preparation of the skins for market, are more than a dozen in number. Among them are the striped skunk, the little spotted skunk or "civet cat," mink, weasel or "ermine," otter, the different kinds of foxes, mole, muskrat, and beaver. The amount of American-grown raw fur available for the markets has decreased, it is said, from 25 to 50 per cent in the last ten years. Our great fur sales of today must be stocked from all parts of the world, and manufactured furs in 1919 brought prices 200 per cent higher than they did two or three years back. Mr. Dearborn, who has spent many years on this particular problem of investigation, gives specific constructive advice relative to the conservation of fur-bearing species and the permanent improvement of America's wild fur.

[1] Separate No. 823, reprinted from the *Yearbook* of the United States Department of Agriculture, 1919.

Dr. James Wilson, secretary of agriculture during the administrations of President McKinley, President Roosevelt, and President Taft (1897–1913) and previously professor of agriculture in Iowa Agricultural College, died on August 26.

Dr. Rodney H. True, who has had charge of physiological investigations in the United States Department of Agriculture, has resigned from the department to accept the chair of botany in the University of Pennsylvania.

The Crop Protection Institute, a coöperative group of investigators of insect pests and plant diseases and representatives of companies manufacturing poisons used in fighting these destructive agents, has been organized with the assistance of the National Research Council. Mr. Harrison E. Howe, chairman of the Division of Research Extension of the Council, is temporary secretary.

Two new magazines in the field of archæology and anthropology have been inaugurated in Mexico. *El Mexico Antiguo*, under the editorship of Herman Beyer, is devoted to the archæology, ethnology, folk-lore, prehistory, ancient history, and linguistics of that country; *Ethnos* will appear as a monthly review of the anthropological sciences in Mexico and Central America. The editor of the latter, Manuel Gamio, is director of the division of anthropology in the Department of Agriculture. He is widely known as the author of general works on the development of Mexico and Latin America.

The sources and authenticity of the history of the ancient Mexicans as revealed by the surviving pictographic codices and maps are the subject of a recent monograph.[2] Several of these Mexican documents antedate the Spanish Conquest and recount the ancient migrations (probably from southwestern United States), the subjection of Mexico, and the founding of the Aztec Empire. Dr. Radin discusses the degree of reliance with which these records may be accepted and concludes that they should yield a fair account of Nahuan and Aztec history from at least about 1109 A.D. There

[2] *University of California Publications in American Archæology and Ethnology*, Vol. XVII, No. 1, 1920, pp. 1–150. By Dr. Paul Radin.

is great need for a critical edition of all these ancient sources and for a search for undiscovered codices that undoubtedly lie forgotten in some of the older libraries of Europe. Dr. Radin reproduces in part the oldest known codex, the *Codex Boturini*, and several of the maps, and gives translations of certain of the commentaries.

THE application of anthropological methods to tribal development in New Guinea (Papua) is presented [1] by Lieutenant E. W. P. Chinnery, formerly acting resident magistrate in the Delta Division of Papua. The problem is one of universal application, namely, how to stabilize primitive institutions so that the development of the culture of a savage people can proceed by way of something tangible to a higher plane of moral and social ideals. For this it is necessary to uphold the indigenous culture except where it conflicts with these moral and social ideals. The most difficult savage custom with which a government has to deal is homicide in its various forms such as head-hunting and cannibalism. Among some tribes in Papua killing a man was a necessary accomplishment before a male could become an adult member of his tribe. "If homicide," says Lieutenant Chinnery, "be an essential link binding together the social and religious fabric of a community, the suppression of homicide is likely to result in the collapse of the whole structure unless something equally capable of perpetuating tribal welfare is substituted to fill the void." Such a substitution, successfully accomplished, is narrated in the case of a tribe which had been in a state of disaffection for nearly five years due to the presence of a government station which prevented initiation of its youth, by prohibiting homicide. It was finally decided by the chiefs that the essential element in the custom that a youth must kill a man before he became eligible for initiation, was the demonstration of courage, which could be just as well proved by the killing of a wild boar. The result of this compromise was highly satisfactory to both the natives and the government. "My experience in Papua," concludes Lieutenant Chinnery, "has convinced me that only by developing the natives and their cultural institutions together can we hope to give them a civilization more beneficial than the primitive life from which we intend to lead them."

[1] E. W. P. Chinnery, "The Application of Anthropological Methods to Tribal Development in New Guinea." *Journal of the Royal Anthropological Institute*, Vol. XLIX, 1919, p. 36.

DR. CLARK WISSLER, curator of anthropology in the American Museum and president of the American Anthropological Association, has pointed out in a paper on "Opportunities for Coördination in Anthropological and Psychological Research"[2] how the two sciences are differentiated. The one is concerned with the mental processes of the individual while the other studies races and cultures as group phenomena. Points of contact between the two sciences, however, are multiform, for an understanding of the group presupposes knowledge of its elements, and in a study of the individual one must consider the social conditions within which he moves. A concrete example of a problem in the solution of which joint psychological and anthropological "engineering" would find a place is presented by the program of Americanization in which the country is at present interested. This program involves many subsidiary problems, some psychological, some anthropological, such as the identification of racial characters, the inheritance of morphological and mental traits, the effect of environment upon individual development, and the psychological factors of cultural change. Applied psychology has been for many years a study fundamental to the science of pedagogy and it is now apparently finding a place in industrial management. The day of the anthropological engineer is just dawning, but he has already made a beginning in the handling and training of various foreign labor groups. "The hope of mankind is that science will point the way to correct procedure even in matters of education and social adjustment. The power of science, when its efforts are coördinated, was clearly demonstrated during the war. It needs no defense now. It is for psychology and anthropology to live up to the reputation of science as a whole."

MR. SYLVANUS G. MORLEY returned to Washington in July after an absence of several months in Central America, where he has been in charge of the Carnegie Institution expeditions.

[2] *American Anthropologist*. Vol. XXII, 1920.

The work of Mr. Louis R. Sullivan in the Southern Pacific will give the American Museum a good racial exhibit of Hawaii as a type for Polynesia. The ethnological studies of the American Museum in coöperation with the Bishop Museum of Honolulu under the direction of Mr. Sullivan will include a comprehensive survey of all the peoples of the Hawaiian Islands. Special attention will be given to Hawaiians of pure blood and of mixed blood.

Evidence of a crude practice of surgery, involving the support of a fractured arm by wooden splints, has been brought to light by a recent excavation at the Pueblo ruin at Aztec, New Mexico. The skeleton is that of a girl of about twenty years, who had suffered a severe injury, fracturing the left forearm and the hip. The latter was apparently beyond the primitive surgeon's skill, but the forearm was surrounded with wooden splints, well shaped and carefully bound in position.

The Sixth International Sanitary Conference of the American Republics will meet December 12–20 in Montevideo, Uruguay, under the presidency of Dr. E. Fernandez Espiro. This Pan American Congress will discuss important problems of public hygiene, sanitary law, and epidemic diseases.

Dr. Frederic S. Lee, professor of physiology in Columbia University, and Dr. Graham Lusk, professor of physiology in Cornell University Medical College, have been elected members of the board of the Institut Marey, a physiological institute in Paris.

That the subepithelial collections of lymphoid tissue found in the tonsils, adenoids, vermiform appendix, and elsewhere in the body, are not useless vestigial relics which should be removed at the least excuse, but are glands which play an important part in immunizing the body against pathogenic bacteria has been maintained by Dr. K. H. Digby.[1] These glands are continually ingesting bacteria and so producing natural immunity after the manner of inoculation for artificial immunity. They bear the brunt of the attack in infections such as scarlet fever, typhoid fever, and appendicitis, and in some cases diseases may be entirely localized in these glands so that the patient apparently secures immunity through mere exposure or a mild attack, as of tonsilitis. A more recent experiment [2] on the regeneration of the appendix of the rabbit tends further to show that that organ plays some important rôle in the economy of the organism. After amputation of the rabbit's appendix the terminal portion of the cæcum generates a new appendix histologically and physiologically similar to the normal organ.

The death-rate from tuberculosis, declining at an accelerated rate, has dropped nearly 60 per cent since 1865 so that there is definite hope that the disease is dying out. Dr. Louis Cobbett, lecturer in pathology at the University of Cambridge, summarizes the situation in a recent issue of *Discovery* comparing the decline of tuberculosis to the disappearance of leprosy which was at one time a common scourge, but is now practically extinct in the western world. The cause of the decline of tuberculosis, according to Dr. Cobbett, is the "amelioration of social conditions" through decrease of overcrowding, politer manners, more and better food, and the "cult of the open window." The World War has set back the victory over tuberculosis probably more than fourteen years in England. On the Continent, especially in Austria where semistarvation has prevailed, tuberculosis has run riot.

Mr. W. J. Matheson, president of the biological laboratory at Cold Spring Harbor of the Brooklyn Institute and scientific adviser in chemistry to the Board of Health for the city of New York, has received the honorary degree of doctor of laws from the University of St. Andrews, Scotland.

Mr. Arthur J. Jacot, who for two years has been engaged in cataloguing the mollusk collections of the American Museum, left the museum in August to teach biology in the North China Language School, Peking.

The artificial propagation of oysters has hitherto proved impossible through inability to change the water without losing the microscopic young. Mr. W. F. Wells, biologist

[1] *Immunity in Health.* The Function of the Tonsils and Other Subepithelial Lymphatic Glands in the Bodily Economy. Oxford University Press, 1919.

[2] *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences,* Tome 170, No. 16 (19 Avril 1920), p. 960.

of the New York State Conservation Commission, has overcome this difficulty by using a centrifugal machine which concentrates the millions of minute forms sufficiently to allow transference to a fresh supply of water. He has thus made possible the maintenance of the animals until they have "set" or attached themselves to available objects, whereupon they can be handled and moved to suitable growing grounds. This puts oyster culture on a par with the now widely used fish culture.

A collection of fishes, representing species especially valuable for study, was secured in Hawaii for the American Museum by Dr. B. W. Evermann, director of the Museum of the California Academy of Sciences, while in attendance at the Pan-Pacific Congress.

Dr. Hikoshichiro Matsumota, assistant professor of palæontology in the Northeastern Imperial University, Japan, is making his headquarters at the American Museum while on a visit of several months to the United States. Professor Matsumota, who has previously published several papers on Pleistocene and later Tertiary mammals and reptiles of Japan and China, is now engaged in studying the prehistoric human remains of Japan.

The bust in bronze of John Muir, a half-tone reproduction of which appeared in the March-April number of Natural History, was presented to the American Museum by Mrs. E. H. Harriman. The bust was modeled by Miss Malvina C. Hoffman, a well-known American sculptor, pupil of Rodin and of Borglum. She has exhibited her work frequently both in this country and abroad and received first honorable mention in the Salon, Paris, in 1910–11.

On October 27 the sixty-second anniversary of the birth of Theodore Roosevelt was commemorated beside his grave at Oyster Bay. Among the organizations sending representatives were the New York Botanical Garden, the Torrey Botanical Club, the New York Horticultural Society, the American Museum of Natural History, the National Association of Audubon Societies, the American Scenic and Historic Preservation Society, the Brooklyn Institute of Arts and Sciences, and the New York Bird and Tree Club.

Mr. Show Shimotori, one of the ablest artists on the staff of the American Museum, has returned to Japan on an extended leave of absence. For the last eleven years Mr. Shimotori has been associated with the department of invertebrate zoölogy as one of a corps of skilled artists and modelers engaged in preparing the series of "window groups" in process of installation under the direction of Mr. Roy W. Miner. In this work Mr. Shimotori is responsible for the remarkably accurate and artistic coloring of the thousands of models of sea animals and plants comprising these groups, but the character of his work is particularly well shown in the realistic coloring of the transparent backgrounds which form part of the setting. In some cases these are photographs on glass which he has colored by hand. In others, an unusual submarine effect has been produced by coloring on successive sheets of plate glass in such a way that when placed one before the other, the whole is blended into one composition. The work of Mr. Shimotori was not confined to the laboratory; he accompanied many of the department's expeditions, and his work as field artist called for adaptability and versatility as well as artistic skill.

Now that the New York Aquarium has a collecting boat, the "Sea Horse," which explores the salt waters of this neighborhood, the American Museum's department of ichthyology through friendly coöperation will learn many new facts about the movements of marine fishes.

Mr. Julian A. Dimock has been elected a patron of the American Museum in recognition of his gift of 3874 photographic negatives, including large series on many natural history subjects.

Dr. W. D. Matthew, curator of vertebrate palæontology in the American Museum, New York, left in August for a visit to the museums of Europe. He expects to return some time in December.

The preservation of inland lakes and marshes in the interest of bird conservation in lieu of their indiscriminate drainage is recommended by Dr. E. W. Nelson, chief of the Biological Survey. The perpetuation of inland lakes and inland and coastal marshes is necessary to provide feeding and resting places for our migratory wild fowl. Even from the economic standpoint these lands probably, under proper protection, would prove of more value to the community in the game they yield than as agricultural lands.

THE American Museum has long maintained a special collection of the birds found within fifty miles of New York City, grouped together in a separate exhibit. In connection with this local group is arranged monthly a seasonal display containing only those birds which may be expected during the current month. This gives a sort of picture of the bird life of the month and facilitates the identification of any recently observed bird. Dr. Frank M. Chapman, curator of birds in the American Museum, has incorporated this scheme in book form[1] with the aid of 301 drawings in color by Mr. Edmund J. Sawyer. A cabinet of drawings is arranged so as to show in groups the permanent residents, winter visitors, and spring migrants of the northern and southern sections of the eastern United States. On any one plate the birds are drawn to the same scale, so that their relative sizes are apparent, a feature which is an important aid in identification. To these drawings are added 134 pages of what Dr. Chapman calls "labels," giving briefly the distinctive characteristics, habits, and range of each.

[1] *What Bird is That?* A Pocket Museum of the Land Birds of the Eastern United States Arranged According to Season. New York and London. 1920.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patron, JULIAN A. DIMOCK.

Fellow, GEORGE W. KORPER.

Life Members, MESDAMES HELEN A. BELL, HENRY D. PRESCOTT, THE HONORABLE McDOUGALL HAWKES, MESSRS. SIMON A. ALCAIDE, SYDNEY BEVIN, VICTOR D. BEVIN, WM. NELSON CROMWELL, WEBB FLOYD, and JOHN MARSHALL.

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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

NOVEMBER–DECEMBER, 1920

VOLUME XX, NUMBER 5

NATURAL HISTORY

VOLUME XX CONTENTS FOR NOVEMBER–DECEMBER NUMBER 5

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

Subscriptions should be addressed to the Secretary of the American Museum, 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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NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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AT TAI-YUEN-FU THERE ARE TWIN PAGODAS. THE NEARER ONE LEANS ALMOST AS MUCH AS THE TOWER OF PISA

NATURAL HISTORY

VOLUME XX NOVEMBER-DECEMBER, 1920 NUMBER 5

A Winter Journey in Northern China

By MALCOLM PLAYFAIR ANDERSON

NOTE.—NATURAL HISTORY has the good fortune to present to its readers another article by the late Malcolm P. Anderson. We quote from Professor Melville B. Anderson's letter placing his son's manuscript for publication in this magazine: "The article I enclose is no tale of sensational adventure, but a straightforward record of close observation in an out-of-the-way portion of the state of Shansi, China. Such a forest as is here described has become, since the days of Marco Polo, a great rarity in far Cathay. The photographs tell the melancholy story of the ruin of the soil by centuries of erosion, unimpeded by the forests that once covered the mountains."

The Journey

IT was a chilly morning in November when I left my inn at Tai-Yuen-Fu, the capital of Shansi Province, north China, bound on a trip westward into a region almost unknown to foreigners, and where Europeans and Americans are equally unknown to the inhabitants.

Besides muleteers I had with me only my cook and interpreter, Kang, and a Chinese hunter whom I called Joseph and whom I took chiefly as guide. The outfit of food, blankets, ammunition, and instruments was loaded on four pack mules, the loads being so arranged that the men could ride on top as much as they pleased. I had no intention of riding, for I knew I should have no difficulty in keeping up with the mules.

I may explain that this little expedition was only an incident in a systematic survey by myself of a considerable part of eastern Asia for the purpose of obtaining scientific specimens of animals and birds for the British Museum (London Zoological Society). I had heard of the existence of forested mountains in the direction I was taking, and I was anxious to do some hunting and trapping in the region before the coming of the severe winter weather.

Tai-Yuen-Fu is situated in a wide valley running north and south and traversed by the Fen-Ho, a broad, shallow stream of muddy water. Passing out of the west gate of the walled city, we crossed the river by a long, low, narrow bridge built of pine poles and covered with a thick layer of sorghum stalks. Then we began the ascent of the long, cultivated slope reaching from the river to the foot of the western hills. Peasants were flailing their millet that morning, and a few were plowing for winter wheat with teams composed of an ox and a donkey working together in a very docile manner. At one village a festival was in progress, and actors in soiled, fantastic costumes of some previous dynasty were reproducing a drama of mythology in a little, open theater stand. Across the road was a small Buddhist temple, on the steps of which the village dignitaries were gathered to watch the performance while the common people looked on from the narrow street.

After traveling for some hours, we entered a cañon in the treeless hills.

THE DRUM TOWER IN THE CENTER OF TAI-YUEN-FU

A MARKET SCENE ON A STREET IN TAI-YUEN-FU

THE TYPE OF WHEELBARROW USED FOR CARRYING COAL FROM THE MINES

A WHEELBARROW LOADED WITH PUMPKINS ON A STREET IN TAI-YUEN-FU where we began to encounter frequent pack trains of mules with loads of coal from the mines a little above. Large-wheeled barrows also loaded with coal came heavily down the narrow, rocky path, the sound of their squeaking being heard afar. Each wheelbarrow was handled by two men, one guiding and pushing, the other in the lead pulling with a rope. Only the wretchedly poor will toil for a livelihood as these men do in order to get their coal to market. Less frequently we met trains of mules and donkeys loaded with bars of pig iron. As the muleteers seemed willing to keep on, we made no stop at noon that day, so that we reached the summit of the hills rather early.

Here was a hamlet of dugout dwellings, mere burrows in the loess banks. There was no inn, and the only house above ground was built of mud and stone and thatched with millet straw. I had hunted in this neighborhood a few weeks before and was acquainted with the peasant who owned this house, so I was able to get a room for the night. The room was furnished with a "kang" or sleeping platform raised about twenty inches above the ground, built of stones and earth and having underneath an opening for a fire. Here I caused a blaze of pine boughs to be kindled to heat the kang and the room, but, as the fireplace was not provided with a chimney, I was forced to walk about outside until the heating process was finished and the smoke had cleared away. Then, after my supper of boiled rice, Chinese steamed bread which I had brought from the city, and American canned meat, I made myself comfortable for the night by setting my camp cot on the heated platform.

The next day, continuing the journey, we first skirted the side of the summit near which we had passed the night, then took a ridge of the hills leading northward, and came before nightfall down to the Fen-Ho again. Looking at my map, I could not see why it would not have been better to ascend the river to this point, but later I learned that the Fen-Ho makes a great bend which geographers evidently have not discovered. By coming up over the hills we had in fact made a considerable cut-off.

On this second night we stopped beside the river at a village called Ku-chow, which is about thirty-three miles northwest of Tai-Yuen-Fu. The houses of this place are built of gray brick and appear better than the huts of the hills; my inn, however, was as bad as even China can boast. Choosing from several hostelries the one that appeared best, we drove our mules through the great door into the large general room, which was already crowded with muleteers and other travelers. While the animals were being unloaded I looked around. There were no private rooms with the exception of one little place occupied by the innkeeper. The general room had on one side a long kang already crowded with sleepers. Near the door two dirty fellows were boiling millet and sweet potatoes on a stove constructed of stones and earth. The floor was littered with cargoes and packsaddles. Many voices were raised in exclamations and curses, while from the rear, where the animals were stalled in a long shed, came the continual jangle of bells and the braying of mules and donkeys. After a few moments the innkeeper came forward to welcome me, and surrendered to me his little room after turning out several ragged wretches who had been smoking opium there.

The walls of this room were blackened with smoke and loaded with the dust of all the years, no doubt, since the house was built. Under the kang, which was covered with a dirty, tattered reed mat, burned a fiercely hot coal fire which added to my discomfort. The partition separating the squalid cell from the general room was a mere latticework which had once been

A VILLAGE IN THE HILLS WEST OF TAI-YUEN-FU

THE HAMLET WHERE THE FIRST NIGHT WAS SPENT ON THE WAY TO CHAO-CHENG-SHAN covered with paper,—now hanging in dust-loaded shreds,—so that whoever would, might look in on me. Needless to say, there was a crowd of curious onlookers,—so I got out some scraps of paper and had my servant stick them on the lower parts of the lattice. But this did not serve as a sufficient hint: ever and anon some rustic, bolder than his fellows, would burst open the door and stand staring at me. This went on until at last, losing patience, I gave the tenth uninvited guest a broader hint in the shape of a sprinkling of water, whereat he retreated to the great amusement of his companions, who roared with laughter.

The Chinese feed their work animals on chopped grain-stalks, usually millet straw mixed with maize or beans. This is doled out to the beast in small quantities and frequently. So it comes about that a Chinese caravansary is always a noisy place at night; the drivers are continually going out to feed their animals, the while incessantly shouting boisterously at one another and cursing the mules.

On the third day we turned up the valley of a tributary stream which enters the Fen-Ho from the westward. As we advanced, the mountains enclosing the valley to the north and south grew higher and more rugged, still however preserving their bare, yellow appearance. The valley was very stony, being little more than the bed of the stream in which there was at the time but little water. The fields were for the most part restricted to the valley and therefore stony; the villages that we passed were all poor: the mountainsides, too steep and infertile for cultivation, were given up to the pasturage of sheep and goats.

We traveled due west all day, covering a distance of perhaps twenty-five miles, and at nightfall we had almost reached the divide at the source of the stream. Joseph was acquainted with a peasant living in a small hamlet by the wayside, so we put up for the night at his house. The aged grandfather, clad in sheepskin coat and cap, welcomed us with all the ceremony he knew. Vacating the best room in his hut, he turned it over to us for the night. It was a far better place than that in which I had passed the preceding night.

My hunter and the muleteers represented it as impossible to reach the mountain for which I was bound in less than five days, but as I had arranged to go in four, I was determined to make an end on the fourth day. In the early morning we ascended to the divide which I had seen the day before; a slight snow was falling and a strong north wind blowing; all the higher mountains were enveloped in clouds. Looking onward from the pass, I saw no change in the character of the country. I paused on the divide and found that my aneroid barometer recorded an altitude of seven thousand feet; this surprised me but I later found the reading to be approximately correct.

Descending from the pass, still in a westerly direction, down another stony and nearly waterless stream bed, we reached before noon a rather large tributary of the Fen-Ho and a little town called Mi-Yueh-Cheng. The houses here, as at Ku-chow, were of gray brick. It was market day and the street was lined with peasants and merchants displaying their produce and wares on benches and tables as well as on the ground. Here my men wished to spend the fourth night, but I urged them on and so, after a short stop for a lunch, we took the trail indicated by Joseph toward the wooded mountain. That I had reached a wild, sparsely settled region was soon evident, for after we left the village, we passed but few dwellings, while trees and bushes became more and more abundant. We were following a small stream to its source, and late in the afternoon, in a drizzle of rain and snow which had continued all day and now became heavier, we reached another pass about a thousand feet higher than that of the morning. Through a momentary lifting of the fog I now caught a glimpse of the forested side of a mountain not far off. This was Chao-Cheng-Shan and I was glad, for until this day I had searched northern China in vain for a real forest.

Somewhat beyond the pass but still short of the woods we came upon a farmer's place on the steep mountainside. Had Joseph not been acquainted with the people, we might have had difficulty in persuading them to receive us; as it was, however, we were greeted cheerfully and were assigned for the first night to the family room, displacing the wife and children of the young farmer.

The house was a very rude affair,—a group of low buildings of earth and stones, clustered on the four sides of a small courtyard on a slope so steep that the roofs of the lower buildings were about even with the floors of those on the upper side. Most of the rooms were dark and smoke-blackened, but the one that was prepared for me the next day —for I decided to make the place my headquarters—had been newly added and was well lighted by one large window. This room was small but clean, except for the dust which inevitably comes from the earth walls of such buildings. The kang occupied the front of the room, and at the inner end was the fireplace, a mere flue extending under the kang, and in this case there was a chimney. Into the end of the platform over the fireplace were set two large kettles which had to be kept full of water whenever there was a fire, so that I had not only smoke but steam to endure. Moisture from the steam condensed upon the rafters and formed a coating of ice which grew thicker and thicker as the days passed.

The people of this lonely farm were very poor peasants, living by herding cattle and goats on the mountains and by cultivating small patches of ground near their home. They seemed to subsist chiefly on oats and potatoes. Besides the ordinary potato, which is good though small, a tuber about the size of a cherry is extensively grown. The oats they grind and boil into a pudding, or they parch and grind them to flour, and eat this mixed with water. This preparation tastes much like pop corn. Leeks are raised as a delicacy of which the people are particularly fond, and a certain amount of millet is grown.

I had brought with me, of course, my own food, but I purchased potatoes from my landlord and he had a few carrots which were a treat. One evening, by way of a compliment, he sent in to me some food of his wife's cooking. The dish consisted of layers of oaten dough rolled into cones and steamed until thoroughly done. I found it excellent. But after the first night I never went into the family room again, and really saw little of the people. I was constantly busy with my hunting, trapping, and preparation of specimens, and the father and son were at work all day thrashing their crop of oats on the earthen floor behind the house. The women kept inside because of the cold and also, doubtless, on account of shyness.

The Mountain Forest

The morning after my arrival, when I looked out, the sky was clear and the first rays of the sun were gilding the tops of the highest ridges in sight. My hut proved to be near the upper end of a deep cañon stretching from north to south and heading in the forest above. Below I saw only bare, buff-colored mountains and the pass we had mounted the previous afternoon. After breakfast I took my shotgun and ascended the ridge west of camp. Striking a trail on its top, I followed up southward, soon reaching the forest. Here I lost the path which was deep in

THE ISOLATED FARMHOUSE WHERE THE AUTHOR LIVED WHILE HUNTING AND TRAPPING ON THE MOUNTAIN snow and overgrown with bushes; I struck through the thick growth of spruce and larch, taking the direction of what seemed to be the summit. The slope was steep, the forest dense, the soft snow knee-deep, so that I progressed slowly, gaining the top of this portion of the mountain only at the end of two hours. Thence I looked down to the southward on a fine scene of rugged snow-covered mountains, with here and there in the foreground a peasant's dwelling among bare fields on some cañon-side.

Chao-Cheng-Shan is a group of three summits. I was standing on the central mountain which then appeared to me to be the highest. Westward rose a peak, and southeastward was a level-topped summit similar to the one I was on. All the upper northern slopes of this mountain mass were covered with the admirable forest I so long had sought; the southern slopes were also wooded, although less extensively. I saw that morning, in the fresh snow, many tracks of wild animals,—deer, fox, hare, and marten, as well as smaller animals in abundance. I was delighted to find at last so good a place to obtain a variety of specimens. On that occasion, however, I came across no game except three Chinese pheasants, which went sailing across a deep cañon, looking, with their long tails, like huge dragon flies.

Within a day or two I found that a small species of deer is very abundant in this region. Accustomed only to the Chinese hunter with his wretched matchlock gun, they were very tame, and gave me many opportunities for close observation. These beautiful little white-rumped, almost tailless deer frequent the grassy tracts near the edge of the forest in which, if alarmed, they take refuge. They were sometimes solitary, usually in threes and fours; once I saw five together.

Joseph was the first to shoot a deer. He came in one day saying that he had wounded a buck but it had run so far that he could not follow. I insisted on his following it up immediately, whereat he went out again, but I suspected that he did not look for the deer at all. The next day he found it and brought it in,—what was left of it. During the night a leopard had devoured the hind quarters, leaving us the head and fore legs. I took the skull as a specimen and the unharmed flesh for food. A few days later we found a second full-grown male with the hind quarters devoured. As there was no evidence of its having been shot, I suppose it was purely the prey of some leopard, as several of these beasts were about.

The southeastern summit was inhabited by a tiger. I heard of this animal early in my stay but was skeptical until I discovered his tracks in the snow. The animal had lived there for many years and was of course dreaded by the natives, who proposed to organize a drive and rely on me to kill the tiger. A tiger did not mean much to me as a specimen, however, for I was busy with mammals far less known. Moreover, as I had had no experience in tiger-hunting, I felt that it would be more prudent to undertake such an enterprise in company with a veteran of my own race, rather than with a lot of excitable, chicken-hearted Chinamen.

One day about a week after taking up my lodging on Chao-Cheng-Shan, I started out as usual with my gun, and climbed the ridge west of the hut. There were two deer feeding at the edge of the forest; before they became aware of my presence, I had got between them and the woods, so that at my approach they ran down the valley. I followed the mountain-side through the thick woods to the western pass, where heavy fog was coming and going and the north wind was bitter cold. On the trees the fog had formed a most delicate and beautiful covering of ice crystals, and rocks and bushes were also wonderfully decorated.

IN THE WIND-SWEPT WESTERN PASS THE FOG FORMED BEAUTIFUL ICE CRYSTALS ON THE LARCHES

THE WESTERN PASS FORMED A BEAUTIFUL FRAME FOR THE DISTANT VIEW TO THE NORTHWARD

THE MOUNTAIN OF CHAO-CHENG-SHAN FROM THE NORTH. IN THE OPEN ON THE EDGE OF THE FOREST ROE DEER WERE VERY ABUNDANT

THE PEAK OF THE MOUNTAIN CALLED CHAO-CHENG-SHAN AND AN ARM OF THE NORTHERN FOREST

FROM CHAO-CHENG-SHAN ONE LOOKS OUT ACROSS MANY RIDGES OF TREELESS MOUNTAINS

LOOKING NORTHWARD FROM THE SIDE OF CHAO-CHENG-SHAN

Caring nothing for the cold and fog but feeling an impulse to go on, I found a trail skirting the southern side of the western peak, and this I followed until I was far beyond anything I had previously seen. The fog, which had been coming and going at frequent intervals, now settled about me densely. It occurred to me that I might get above the fog by going up; hearing the sound of some animal above me, I climbed some hundreds of feet up a ridge to see what it was, but the animal proved to be too far away, and an unknown cañon, filled with fog, yawned between me and the object of my search. Supposing that I could ascend the ridge and then easily descend again to the pass, I pushed on up through the snow and the fog, but in doing so I lost my bearings and became aware that I no longer knew in which direction the pass lay. Thinking to regain my little trail, I began to go down again, and soon found myself in the forest. On my way up I had not seen any trees; the fog, I thought, must have hidden them.

Down and farther down I plunged through the soft snow, and no trail could I see,—nothing but the trees a few rods ahead. At length I began to suspect that I was on the northern slope, and if so, I knew that if I got too low I might have difficulty with some deep and very precipitous cañons. I thought of turning back, following my tracks, but that would be a toilsome business, and by that route I could not hope to reach camp before dark. The sun,—where could it be? If I could but see the faintest indication of its direction! It must be near setting, but there would still be an hour of daylight. Suddenly I came to an opening, then to a trail running horizontally along the mountain. Thinking I had observed such a trail along the northern slope, I felt rather relieved, and turning to my right, eastward as I supposed, followed the trail.

After some time I mounted a ridge; it seemed to me that at last the pass was regained; if so, I must find my own tracks in the snow. In the fog the place looked wonderfully like the pass, but there were no tracks of mine. There as I stood in doubt, I saw, through a momentary lifting of the fog, not the crag that should rise on the opposite side of the divide, but a sheer cañon opening at my feet. I was certainly lost. There was no time to hesitate: I must make use of every instant of daylight in retracing my tracks. Unbuttoning my coat, I ran as steadily as possible back along the trail. Darkness would soon come down, probably long before I could climb back up the mountain. With that fog how dense the darkness would be! Feeling in my pocket for matches I found not a single one. If worst came to worst I might descend some cañon in search of a peasant's hut; but how would the people receive me, a foreigner whom they could not understand? They might think the evil spirit had paid them a visit! I thought of the other time that I had been lost in the mountains far away in Siskiyou, but that seemed nothing to this. There I had built a fire and calmly lain down to sleep, while here, if I failed to find a hut, I must walk all night to keep from freezing. There, the air had been but chilly, while here it was bitter cold with a wind blowing direct from the winter-bound desert highlands of the north.

Suddenly I paused in my run. The fog below had lifted a little, giving me a momentary glimpse of a peculiar seam of rock which I had noticed, traversing the country and forming cliffs on the sides of several cañons. I must therefore be on the northern slope! I was right when first I followed this path. Turning once more, my confidence restored, I passed along the mountainside again, and when, a second time, I reached the ridge which had seemed to be the saddle but was not, there only a few hundred yards ahead was the actual pass. It was still rather foggy, but unquestionably the place I knew. The way to camp, though long, was now perfectly clear.

That night, as I slipped between my warm blankets, I thought again of my California experience and congratulated myself that it still remained the only time I had been lost for a night in the mountains.

The next day the fog left, not to reappear during my stay. The weather turned even colder; the little stream near camp, which had hitherto been running under the ice, now froze solid, and the mercury in my thermometer retired entirely into the bulb.

On the last day of November I set out to ascend the western peak, Mo-er-shan, the highest portion of the mountain. The day was clear and I expected a fine view from the summit. A tramp of an hour took me to the western pass whence I followed the track skirting the southern slope. This led me at first through an open tract, but soon, surmounting a rocky spur, I entered a thick hemlock forest that filled the head of a large cañon. Through this I made for the main ridge, which would lead me directly westward to the peak. On mounting the ridge, I found the going much less to my taste than I had thought it would be. Before I had reached the ridge, the hemlock forest of the south side had given place to a thicket of big, thorny plants much like the devil's-club of Alaska. It is a large-leaved plant about waist high, with long, poisonous thorns on both stalk and leaves. I found that the dense spruce forest of the northern slope met this thicket at the top of the ridge, so that I had to choose my way through one or the other. Among the trees the snow had drifted about two feet deep but had not settled and hardened. It had only a slight crust, enough to make me think now and then that it might hold me, but I plunged in at every step. Nevertheless, I held my way as much as possible in the forest until I reached the base of the peak, where the trees cease.

The peak proved to be composed of a mass of great fragments of granite, half-covered with snow and overgrown with low, thorny bushes. On account of the snow I found it difficult to tell whether the foothold was solid or whether I was stepping between the rocks into some crevice. I had not gone far before I hurt myself; after that I went cautiously, and eventually reached the summit.

North, south, and east, I looked over a seemingly endless succession of mountain peaks and deep, narrow valleys, stretching out and out until their outlines were lost in yellow haze. With the exception of a massive eminence far to the north,—which proved to be Ko-Lan-Shan,—no mountain appeared so lofty as the peak on which I stood. Westward I looked down upon loess hills, all artificially terraced and seamed by gullies where watercourses and roadways traversed them. Far out to the west, stretching from north to south as far as one could see, was a blue line marking the gorge of the Yellow River.

Stopping on the summit was extremely unpleasant on account of the icy wind from the north, but I did not neglect to read my barometer, which recorded an altitude of 11,800 feet. After reconnoitering the western side in search of a good way down, I descended the southern slope by jumping, at first, from rock to rock. Getting among the devil's-club and the smaller rock fragments, I was obliged to pick my way with greater heed. Although this route compelled me to cross two deep and precipitous cañons, I managed to reach the hut at an early hour in the afternoon.

The cold on Chao-Cheng-Shan became constantly more severe; and, as I had made a highly interesting collection of mammals and birds, I was glad to return early in December to more comfortable quarters in Tai-Yuen-Fu.

HORN OF INDIAN RHINOCEROS KNOWN AS ALICORNE OR UNICORN

Presented to Pope Gregory XIV, in 1590, because of its reputed medicinal qualities, by the Prior and Brothers of the Monastery of St. Mary of Guadalupe, Spain. This inscription runs around the rim of the cover while the top of the cover bears the arms and superscription of Pope Gregory XIV.

The missing tip, reduced to powder, was administered to the Pope in his last illness. The statement that it was used as an amulet is entirely erroneous. The horn was purchased by Dr. L. Pollak, of Rome, at the Ferroni sale of 1909, from whom it was obtained by Mr. John Marshall, who, at the suggestion of Dr. Bashford Dean, presented it to the American Museum in 1920

The Unicorn and His Horn

By FREDERIC A. LUCAS

"THE unicorn," writes Pliny, "has the head of a stag, the feet of an elephant, the tail of the boar, while the rest of the body is like that of the horse; it makes a deep lowing noise, and has a single black horn, which projects from the middle of its forehead, two cubits in length. This animal, it is said, cannot be taken alive."

One might suppose from the detailed description that it was written by some one who had actually seen the animal; in reality it has no firmer foundation in fact than the tusks of the narwhal, all the rest being supplied by the imagination of the writer.

The old zoölogists were indeed gifted with vivid imaginations, although, as animal psychologists, they were far behind some of the writers of today, for none of them ever credited a woodcock with surgical skill, much less a sponge with sufficient intelligence to adapt the time of laying its eggs to the currents and temperature. So, given the horn of the narwhal, the rest could be added. After all, this is not so surprising, for even today there is a widespread belief that a palæontologist can restore an animal from a single bone, a belief, it is needless to say, more flattering than accurate.

There are times when the early zoölogists seem a little hazy, and he who is following the trail of the unicorn through the pages of the literature of the past will find a tendency to confuse the unicorn with the rhinoceros, although the best systematists distinguished these under the term of monoceros or monocerate.

Thus Guillim, who wrote on heraldry in 1610, says: "The Unicorn hath his Name of his one Horn on his Forehead. There is another Beast of a huge Strength and Greatness, which hath but one Horn, but that is growing on his Snout, whence he is called *Rhinoceros*, and both are named *Monoceros*, or One-horned. It hath been much questioned among Naturalists, which it is that is properly called the Unicorn: And some hath made Doubt whether there be any such Beast as this, or no. But the great esteem of his Horn (in many places to be seen) may take away that needless scruple. . . . Touching the invincible Nature of this Beast, Job saith, 'Wilt thou trust him because his Strength is great, and cast thy Labour unto him? Wilt thou believe him, that he will bring home thy seed, and gather it into thy Barn?' And his Vertue is no less famous than his Strength, in that his Horn is supposed to be the most powerful Antidote against Poison: Insomuch as the general Conceit is, that the wild Beasts of the Wilderness use not to drink of the Pools, for fear of the venemous Serpents there breeding, before the Unicorn hath stirred it with his Horn. Howsoever it be, this Charge may very well be a Representation both of Strength or Courage, and also of vertuous Dispositions and Ability to do Good; for to have Strength of Body, without the Gifts and good Qualities of the Mind, is but the Property of an Ox, but where both concur, that may truly be called Manliness. And that these two should consort together, the Ancients did signify, when they made this one Word, *Virtus*, to imply both the Strength of Body, and Vertue of the Mind. . . .

"It seemeth, by a Question moved by *Farnesius*, That the Unicorn is never taken alive; and the Reason being demanded, it is answered 'That the greatness of his Mind is such, that he chuseth rather to die than to be taken alive: Wherein (saith he) the Unicorn and the valiant-minded Souldier are alike, which both contemn Death, and rather than they will be compelled to undergo any base Servitude or Bondage, they will lose their lives.' "

Whatever uncertainty there might be as to the animal, there was none as to the medicinal value of the horn, be it that of unicorn, alicorn, monoceros, or rhinoceros.

The standard works on zoölogy and medicine from the time of Pliny onward all testify to the potency of the horn of the unicorn, and to these well-known authorities, Mr. John Marshall has added some interesting extracts from a work compiled by Andrea Bacci, of Florence, in 1573, entitled *L'Alicorne, della sua natura et della sue virtu.*

Thus Bacci, quoting Signor Mundella, "the highest authority of all," states that he places a high value on the monoceros horn as an antidote against poison and the bites of mad dogs and other poisonous animals, while various authorities consider it efficacious against pestilential fevers, bubonic plague, and even mushroom poisoning. And yet Mundella—as he ingenuously admits a little later—had never even seen a horn!

If we marvel at the credulity of the learned men of the Middle Ages, at their taking so many things on faith, we have only to recall a few of the fads of the present generation. It is not so many years ago since the blue glass craze swept over the land; yesterday we were seeking earthly immortality by drinking sour milk; today it is the light-hearted yeast cake that is to lengthen our days; tomorrow it will be "something just as good."

And if it seems strange that no one considered it remarkable that a patient sufficiently wealthy to procure a dose of unicorn powder should die, the explanation was simple: either the precious horn was given too late, when the patient was *in extremis*, as was the case with Pope Gregory XIV, or the dose was too small. Truly a difficult answer turneth away argument.

That it was not used more commonly was on account of its rarity and price. For unicorn horn was not a poor man's medicine; it was reserved for princes and potentates, the capitalist class of those days; the quotations on unicorns vary from $12,000 upward, extra fine being valued at $150,000 or, considering the purchasing power of money then, about half a million dollars of our present currency.

From Bacci we gather that it was given for mushroom poisoning as well as for other ailments. The customary dose was about ten grains administered either in wine or water, and it was well to give at the same time an emetic—an item that possibly accounts for its success in curing mushroom poisoning.

There seems to have been a belief that the medicinal value of a drug or other substance employed in medicine, bore some relation to its scarcity and costliness. Thus we are told that Gregory XIV was kept alive for some days by the administration of gold and jewels, although at the last the horn of the unicorn failed to preserve his life.

This very horn, now of historic interest, and all the more valuable because it lacks the tip administered to Pope Gregory when *in extremis*, has just been presented to the American Museum by Mr. John Marshall. As we learn from the inscription around the cover of the case in which it was preserved, it was presented to Pope Gregory XIV in 1590, by the Prior and Brothers of the Monastery of St. Mary of Guadalupe. It is just possible that it was given because it was known that the Pope was already in poor health and there could be no better gift than a restorative. Be this as it may, the incumbency of Pope Gregory XIV was brief, lasting but a year, and the precious horn that was administered at the last proved unavailing.

Now and then some bold spirit seems to have been skeptical as to the value of some of the drugs in vogue, and Mr. Marshall quotes Muratori who, writing of the very case we have considered, says, "From the historian's statement he [Pope Gregory] was kept alive for a few days by virtue of the gold and jewels they gave him, he paying as a fee the sum of $15,000. We must conclude that the good Pope either had about him some quack doctors or very slick thieves." But heresy such as this is rare indeed and there is possibly a bit of professional jealousy here of the man who received a fee of 15,000 scudi.

As Lincoln said, there is a great deal of human nature in most people, and no matter how far back we go in the past, we find the same tendencies as nowadays. So it is not surprising to learn that there were counterfeits of so precious a drug as unicorn's horn, although these might be recognized by giving "Red Arsenic or Orpiment to two pigeons, and then to let them drink of two samples; if genuine, no harm would result—if adulterated, or false, the pigeons would die."

The unicorn is mentioned several times in the Old Testament, or rather the term *reem* has been translated to mean *unicorn*, but although all that is said in the Book of Job and elsewhere would apply to the rhinoceros, it is now considered that the word applied to the wild ox.

"Will the Unicorn serve thee, or will he tarry by thy Crib? Canst thou bind the Unicorn with his Band to labour in the Furrow or will he plough the Valleys after thee?" [1]

The zoölogist is at a loss to understand where the Israelites could have made the acquaintance of either the rhinoceros or the wild ox.

How the unicorn came to symbolize the Holy Spirit and how it found its way into heraldry, simply changing its Italian name *alicorne* to *licorne*, books at hand do not tell, but it became popular with Scotch heralds. A pair was taken, as we know, for supporters on the arms of the King of Scotland and, upon the accession of James VI to the throne of England as James I, one of them was transferred to the English royal coat of arms, where today it still stands on guard with the lion.

[1] Job, Chap. XXXIX.

The arms of the King of Scotland. From Grant's *Manual of Heraldry*

CENTRAL ALBERTA IN THE TIMES OF THE DINOSAURS

A broad, swampy delta with semitropical vegetation bordered the great interior sea that extended north from the Gulf of Mexico. Here lived the great dinosaurs of the Cretaceous period. The picture shows three kinds of duck-billed dinosaurs whose skeletons were found in the "bad lands" along the Red Deer River (see cut on page 537) and which may be seen in the museums of New York, Toronto, and Ottawa. Restoration by R. Deckert. (*After Barnum Brown*)

The American Museum fossil camp on Red Deer River, Alberta. The bad lands in the background show the geological formation in which the dinosaurs occur

Canadian Dinosaurs

By W. D. MATTHEW

UNTIL recently Canada has not been considered a very promising field for the fossil hunter. Considering the area of the Dominion and the amount of first-class geological surveying that has been done there, the number of important fossil finds is surprisingly meager. The reason might be partly that the "bad lands" which afford such favorable conditions for fossil hunting in the western United States are very little developed in Canada. There are no deserts, and even the arid or semi-arid areas are of limited extent.[1] The covering of vegetation over practically the whole country conceals from view such specimens or indications of fossils as may be exposed by erosion, and there is but little opportunity for systematic search of the outcrops of the rock formations. Moreover, the glaciers which covered the greater part of the Dominion during the great Ice age, have swept away all of the surface soils and much of the softer rocks of the later geological periods, redepositing them as moraines and other glacial deposits, but utterly destroying whatever fossil bones they may have originally contained.

[1] About 20,000 square miles of Canada, mostly in southern Alberta, have a rainfall of less than ten inches. The forest areas, on the other hand, cover more than 2,000,000 square miles, of which it is estimated that 1,250,000 square miles are actual woodland.

Some Notable Fossil Finds in Canada

In spite of these handicaps, some notable discoveries of fossils have been made in Canada. Among these is the discovery of the (then) oldest known terrestrial quadrupeds in fossil tree stumps in the South Joggins coal measures of Nova Scotia. This was a famous find in its day, and is still important in palæontology.[2] Of more recent discovery but in an older geologic formation are the wonderful specimens of fossil fish from the Devonian shales of Scaumenac Bay, on the Gaspé coast of Quebec.[3] More

[2] Some of these specimens are in McGill University Museum, Montreal. Others are in the British Museum or elsewhere in London.

[3] The finest specimen from this locality was obtained by Professor William Patten for Dartmouth University, but there are many fine specimens in various museums of the United States, Canada, and England. The American Museum has a valuable series.

ancient than these, but even more marvelous in their perfect preservation, are the Cambrian invertebrates obtained by Dr. Charles D. Walcott in recent years in British Columbia.[1]

The Alberta Dinosaurs

The dinosaurs of the Red Deer River in Alberta are of more popular interest than any of these finds and are equally important to science, although by no means so ancient geologically. The American Museum has taken a principal part in the discovery and collection of these dinosaurs and in scientific researches upon the specimens. It may therefore be of interest to members of the museum to sum up what has been done here and elsewhere.

The first important discoveries of dinosaurs in Alberta were two skulls collected on the Red Deer River by Tyrrell in 1884 and Weston in 1889, and described by Professor Cope as carnivorous dinosaurs. In 1897 to 1901 Lawrence Lambe, the Canadian palæontologist whose death was noted in NATURAL HISTORY, made considerable collections in this district, mostly of very fragmentary material, which were described in a memoir by Professor Henry Fairfield Osborn and Mr. Lambe in 1902. A few years later a letter from Mr. John C. Wegener, a ranchman at Tolman, Alberta, called the attention of Mr. Barnum Brown of the museum to the great abundance of dinosaur bones in certain areas on the Red Deer River. This served to crystallize Professor Osborn's plans for a thorough exploration of this promising fossil field, where Mr. Barnum Brown spent seven seasons, from 1909 to 1915. He found it advisable to devise new methods of exploration, which are described in an article in the AMERICAN MUSEUM JOURNAL for December, 1911, "Fossil Hunting by Boat in Alberta." The collections obtained were very large and extraordinarily complete, including a series of articulated and more or less perfect skeletons of various kinds of dinosaurs. These collections are now at the American Museum; our preparation staff has been at work upon them ever since and will be busy for some years to come before all are prepared for exhibition.

Meantime the Canadian Geological Survey undertook a vigorous and very successful campaign in the same district from 1912 to 1916, enlisting the veteran collector, Mr. Charles H. Sternberg, and his sons, to work under Mr. Lambe's direction. A fine series of skulls and skeletons was obtained for the Survey collections and the preparation and description of these specimens were well advanced when halted by the exigencies of the great war and by Mr. Lambe's sudden illness and death in the midst of his researches.

Several other institutions, notably the Calgary Museum, the University of Toronto, and the British Museum, have obtained important material from this rich fossil field, which, as Mr. Brown has pointed out, is likely to be practically inexhaustible, new specimens being exposed year by year owing to the comparatively rapid erosion by rain and river.

The American Museum Collection of Alberta Dinosaurs

At present there are nine complete skeletons of dinosaurs from the Red Deer River on exhibition in the American Museum, besides six skulls and two partial skeletons. Five more skeletons are being prepared, and various other specimens remain as yet untouched. Nearly half of our entire dinosaur exhibit at present is from this district; in a few years it will be more than half.

Nearly all the skeletons are exhibited as panel mounts, that is to say, they are chiseled out in partial relief

[1] These are in the United States National Museum. I do not know of any elsewhere.

Skull and jaws of the great armored dinosaur *Ankylosaurus*, "the most ponderous animated citadel the world has ever seen." The broad, squat body of this animal was completely shielded by massive plates of bone. Even the eyes were protected by movable bony curtain lids. Besides skulls and skeletons, two specimens have been found on the Red Deer River with the armor in place. One is in the American Museum, the other in the British Museum

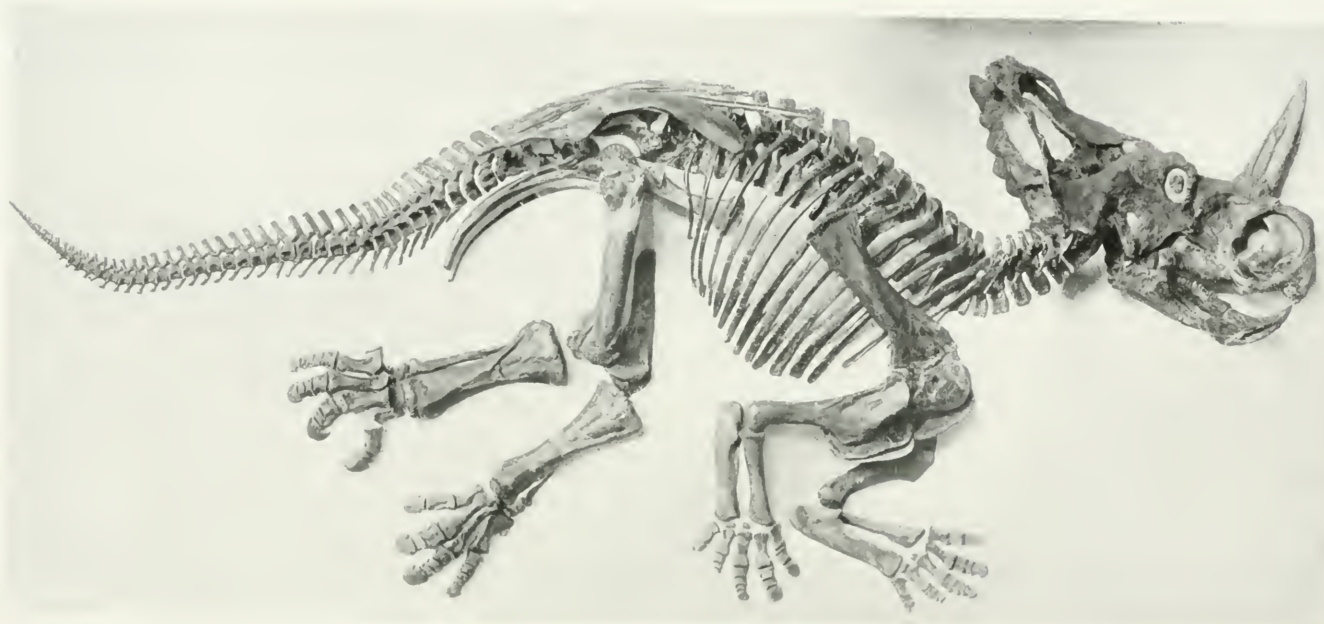
but still remain partly buried in a squared block of the original rock stratum, or in plaster tinted and finished to match it. This is a preferable method when a fossil skeleton is somewhat crushed but well articulated and does not lie confusedly in the rock; it is the necessary method when a skeleton is very much crushed or squeezed flat. The Alberta dinosaurs, while not badly distorted, are usually somewhat crushed, and most of the skeletons collected are very well articulated, so that they can readily be mounted as panels. This method shows immediately that the skeleton is a fossil, and although it does not show the original form of the animal as well as an "open" or "full relief" mount, yet it may sometimes give a more easily seen and better remembered picture than the other.

Readers of this magazine hardly need to be reminded that the "dinosaurs" include a wide variety of extinct animals, as various and diverse in appearance and habits as the "quadrupeds" among modern animals. The dinosaurs of the Upper Cretaceous formations of Alberta included probably as great a variety of animals as the large quadrupeds of Central Africa. We have only a few, probably, of the more common and characteristic kinds, but they are different enough to be worth examining separately and contrasting one with another. All of them are "queer" and strange to our eyes, which are accustomed to see the characteristic forms of the mammalian quadrupeds. Perhaps they would have appeared more natural had we lived during the Age of Reptiles.

There are five principal groups among the dinosaurs, all except the last including quite a variety of different types: (1) Duck-billed dinosaurs or Trachodonts; (2) Horned dinosaurs or Ceratopsians; (3) Armored dinosaurs or Ankylosaurs; (4) Carnivorous dinosaurs or Megalosaurs; (5) Ostrich dinosaur (*Struthiomimus*).

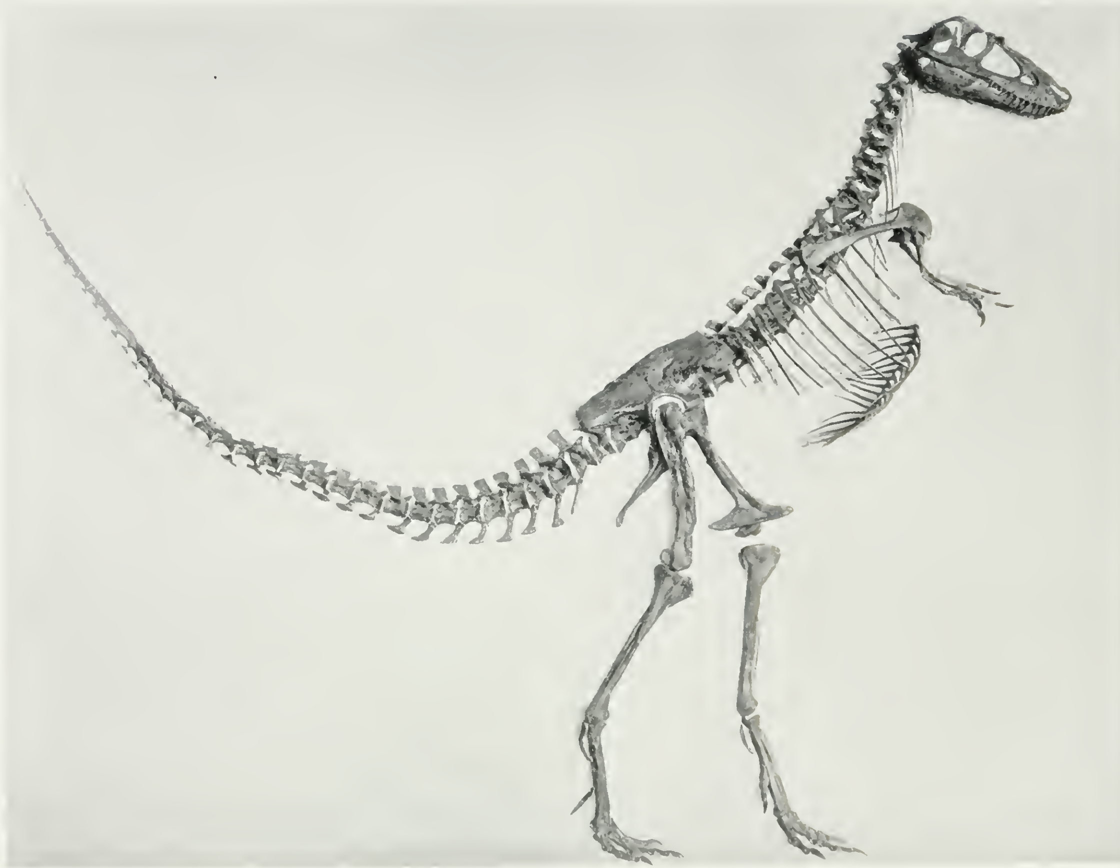
Duck-billed Dinosaurs

There are four skeletons and three skulls to represent this group. The duck-billed dinosaurs or Trachodonts get their name from the flattened, toothless, horny beak or bill. They



SKELETON OF A HORNED DINOSAUR, MONOCLONIUS

This nearly complete articulated skeleton is in the American Museum. It is in position as found in the rock, except for the forefeet which were exposed on the surface, disorganized and partly destroyed by weathering. It had a single large nasal horn and rudimentary horns over the eyes. The *Triceratops* of Wyoming had a large pair of horns over the eyes but the nasal horn was rudimentary. (*After Barnum Brown*)



SKELETON OF A GREAT CARNIVOROUS DINOSAUR, DEINODON

Found by Mr. C. H. Sternberg in the Red Deer River bad lands, and now in the American Museum of Natural History. The skeleton stands about twelve feet high have long, heavy hind legs, rather weak, slender fore limbs, and a long, powerful flattened tail. They seem to have been amphibious, equally fitted for wading or swimming in the water or walking on dry land. On land they would probably walk principally on the hind legs, but could drop on all fours to feed.

Until the discovery of the Alberta dinosaurs there was only one kind known, the *Trachodon*, a huge sort with an enormous wide, flat bill.[1] But in the Cretaceous formations of the Red Deer River, the Edmonton and Belly river beds, a remarkable series of duck-billed dinosaurs has been discovered. Among others there are:

(1) *Saurolophus,* with a smaller bill and a great spike on the back of the skull. Skeleton on exhibition in dinosaur hall.

(2) *Corythosaurus,* with a much smaller bill and a great crest on the top of the skull like a Phrygian helmet. One skeleton with a great part of the skin and another without skin but very perfectly preserved.

(3) *Stephanosaurus* also had a high crest on top of the skull, but of quite different shape. Two skulls in the American Museum exhibit; a skeleton in the Ottawa Museum.

(4) *Prosaurolophus,*—much like *Saurolophus*, but with a rudimentary spike on the head. Skull in the American Museum collection.

(5) *Procheneosaurus,*—a small kind with little bill and short round head. A fine skeleton on exhibition in the American Museum.

(6) *Kritosaurus,*—long, broad, depressed beak and peculiar prominent "Roman nose." Skulls in American Museum and Ottawa; a fine skeleton in the Toronto Museum.

[1] Represented by three skeletons in the museum exhibit,—the group of two skeletons, one standing upright, the other on all fours, feeding; and the "dinosaur mummy" lying on its back with the head tucked under the body and the shrunken skin still covering the bones. These three skeletons are from Montana, South Dakota, and Wyoming, respectively; but all are from the same geological formation, the Lance or latest Cretaceous.

Horned Dinosaurs

These were a very different kind of beast from the duck-billed dinosaurs. They had somewhat the proportions of a rhinoceros, with stout, heavy, short limbs, rather short tail, thick neck and huge head, armed with one or more sharp horns in front, and protected by a great bony crest or "frill" behind. It is supposed that these animals were wholly terrestrial and certainly must have walked on all fours.

Here again the Alberta formations have revealed an unsuspected variety of kinds. The *Triceratops,* whose skull and skeleton have been found in Montana and Wyoming, does not occur, but there are three or more other kinds, especially *Monoclonius,* with a single large horn over the nose (instead of the pair of large horns over the eyes seen in *Triceratops*); *Ceratops,* with horns arranged more like *Triceratops,* but smaller and with a different type of frill. *Anchiceratops* has horns over the eyes, but they spread outward instead of forward, and the "frill" is ornamented with scalloped edges; *Styracosaurus* has a frill set with huge bony spikes; and probably there were others. All of these except the last are represented by one or more skulls in the American Museum exhibit; *Monoclonius* also by a complete skeleton (the only complete skeleton of a horned dinosaur yet discovered) and by a partial skeleton showing a good deal of the skin preserved.

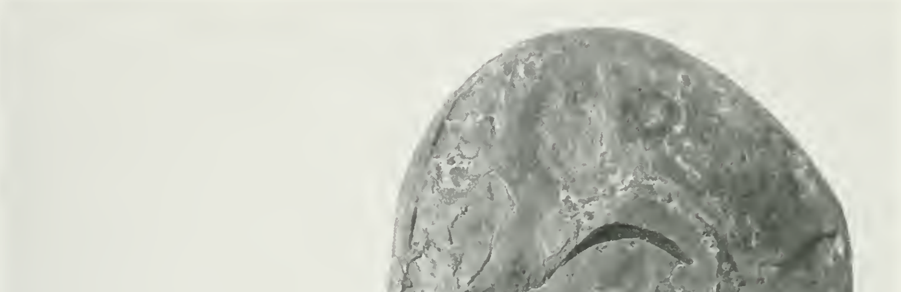
Armored Dinosaurs (*Ankylosaurus*)

This is a third group of vegetarian dinosaurs totally different from either of the others. They had a very small triangular head, enormous wide body covered with large bony plates, short massive fore and hind legs, and a heavy tail armor-plated to the tip.

The armor of neck and tail was arranged in overlapping rings to allow movement, and the limbs probably could be folded in under the wide flat body for protection.

This group of dinosaurs was first discovered by Mr. Brown in Montana, but the best specimens have been found in Alberta, from which we have a series of skulls and other parts on exhibition, and a complete skeleton in preparation, as also a partial skeleton preserving a great part of the skin and armor plates in position. Another partial skeleton with skin is in the Natural History Museum in London.

These three kinds of dinosaurs were all herbivorous beasts, feeding upon leaves and twigs or upon the softer and more succulent water plants. Their teeth were suited for grinding and chewing such food, and the horny plates of the beak would serve to clip it off. Their feet have wide, flattened hoofs on the toes. They are quite unfitted to attack and prey upon other animals, but are able to defend themselves against attack in different ways: the duck-billed dinosaurs by retreating into the water, where their active swimming and wading would enable them to escape; the horned dinosaurs by the great sharp horns and protected skull; the armored dinosaurs by their completely mailclad body. There was, however, another group of dinosaurs, equal-



Skull of ***Corythosaurus***, a duck-billed dinosaur from Alberta. The lofty cranium is not a "dome of thought," for this dinosaur had just as little brain as his low-browed relative, ***Trachodon***. It is simply a bony crest whose shape suggests the casque of the living cassowary; hence the name ***casuarinus***. In all dinosaurs the brain was small and of reptilian type, as in the living crocodiles ly gigantic and remarkable, that was carnivorous, with sharp, cutting teeth and claws adapted to prey upon other dinosaurs or upon smaller animals.

Carnivorous Dinosaurs

All of these were bipeds, running or walking upon the long, powerful hind legs, while the fore legs were often quite absurdly small in proportion. The teeth were sharp, compressed, with serrate edges, and the claws long and curved like those of eagles. The Canadian dinosaurs of this group were not so large as the huge *Tyrannosaurus* found in Montana and Wyoming,[1] but they were formidable beasts, far surpassing any modern beast of prey in size, and proportioned very differently, more like a gigantic lizard, but with the short body, long legs, and three-toed feet of a huge bird. The American Museum has obtained a fine series of skeletons of these great "Deinodonts." Two have been placed on exhibition, the larger one in the position as found, with the head drawn back, the legs sprawled out sideways, and the tail tucked under the body. A smaller species is in a standing pose as though reaching up to peer over the reeds and bushes of the jungle in search of prey. Two other large skeletons are being prepared; one of them, mounted in a running pose, will be on exhibition about the time this article is published. The Ottawa Museum has also a fine skeleton of this type, which Mr. Lambe described under the name of *Gorgosaurus*.

Besides these larger kinds there were also small carnivorous dinosaurs of which only fragmentary specimens have yet been found. They were from six to twelve feet long, more slenderly proportioned than the great Deinodonts, but otherwise similar.

[1] The skeleton of *Tyrannosaurus* is on exhibition in the dinosaur hall of the American Museum. It is 48 feet long, and stands 18 feet high. The jaws are 48 inches long.

The Ostrich Dinosaur

This has been confused with the small carnivorous dinosaurs, but was really quite a different animal. It had a long, slender neck and very small skull, the jaws without teeth, but with a bill like that of an ostrich. The hind limbs were very long and slim, with three-toed birdlike feet; the fore limbs, however, were not reduced as in the Deinodonts, but were also comparatively long and slim, with feet that are curiously suggestive of those of a tree-sloth in their proportions. The claws were comparatively long and were not compressed and curved as in the carnivorous types. This animal has been named *Struthiomimus* or "ostrich mimic" by Professor Osborn. Evidently it was not a beast of prey, but was adapted to some special mode of life; just what is still doubtful, although several ingenious suggestions have been made. A finely preserved and nearly perfect skeleton of the *Struthiomimus* is in the dinosaur hall of the American Museum. It is a rare type, and the next best specimen is a fore limb obtained for the Ottawa Museum by Mr. Lambe.

In addition to all these various kinds of dinosaurs, the Red Deer River has yielded a fine series of fossil turtles, crocodiles, and other remains of less interesting extinct animals. But it is and will continue to be famous as the greatest dinosaur locality in the world, the source of half the American Museum's dinosaur collections and of many choice skeletons that are, or will be, the pride of various other institutions.

A roof of banana leaves.—Our camp was roofed over with the broad-fronded leaves of heavy ferns, or those of a mountain taber; again, the leaves of the wild banana plant were made to do service as a protection against the tropical downpour that assailed us occasionally

Ten Days in Tahiti

By ROLLO H. BECK

THE first word from the American Museum's South Pacific Expedition comes in the form of a communication from Mr. Beck, detailing his experiences during a ten days' bird collecting trip in Tahiti.

HAVING made arrangements for a two weeks' trip into the mountainous interior of the island of Tahiti to study the bird fauna, we locked up the small cottage in Papeete on the morning of October 11 and started for the mouth of the Punaruu River, where our two guides were awaiting us.

The ten-mile motor ride along the western side of the island was very pleasant in the early morning. Minabirds were calling loudly from the tops of the taller trees; beautiful black-capped terns sailed back and forth over the smooth lagoon; a wandering tattler whistled plaintively as it flushed from a rocky point on the shore, while the steady boom of the breakers on the barrier reef a mile off shore was softened by the rustling of coconut leaves as the morning breeze swept through them.

Interspersed with neglected coconut groves were little patches of finely cultivated ground where Chinese gardeners raised in rigidly straight rows the various vegetables for which they found a ready market in Papeete. As the car stopped by the newly painted bridge across the Punaruu River, the guides stepped alongside and soon had our baggage in four sacks which they tied to two stout poles, and, shouldering these, they led off into a narrow trail toward the deep gorge through which flowed the Punaruu. At its mouth the cañon was more than half a mile wide, but it narrowed rapidly until in places it was less than a hundred yards, with precipitous walls on both sides.

Three miles from the entrance we came suddenly to a small tract where an industrious native had cleared off a bit of the steep, rocky hillside and planted it to papaya trees which were heavily laden with green fruit. We walked steadily for three hours, wading back and forth across the stream as one side or the other seemed best, but at eleven o'clock we turned out of the main cañon and picked our way up a little stream that trickled down between two narrow walls. Stopping by a shady pool, Tafia, the leading guide, dropped his load and pointed up the left wall to indicate our route.

A slight trail seemed to lead upward, so after a leisurely lunch, we began the thousand-foot climb, topping the cliffs close by a couple of coconut trees. After a few minutes' rest and a drink of fresh coconut milk, we started forward again through the gloomy forest, emerging finally at a little depression where a grassy pond of water harbored a dozen golden plover recently arrived from Alaska to spend the northern winter season along the Polynesian shores. The migratory habit is strongly implanted in these birds, for, although nesting in Alaska, they range in winter over numerous Pacific Ocean islands, and wander as well over a large part of South America. I remember them swinging into Argentine wheat fields late in September and in March flying about in nervous fashion along the shores of Lake Junin at 13,000 feet in the Andes just before beginning their flight toward the north.

A mile beyond the pond we stopped by a rivulet for the night. We had anticipated making for ourselves a leaf-covered hut, but instead were compelled to tie our canvas sheets together for a shelter, as suitable leaves for roofing grew nowhere near us. The scarcity of birds during the first day was attributed to the rain, for we collected only a dove, a swallow, and a kingfisher; as it happened, however, these were the only three native species taken on the trip.

The next morning was bright and hot, so we decided to stop a day and see what birds were in the vicinity. Tafia started out with Mrs. Beck and myself toward the foot of the towering cliffs that bounded the plateau on the east. Before reaching the base of the cliffs, we began seeing roughly built walls of stone which stood a foot or two above the ground on the lower side, while on the upper the soil had filled in level with the top. We saw dozens of these walls during the day and wondered what the former inhabitants of this rocky hillside once did for a living.

An occasional cooing dove or chittering kingfisher was heard but seldom seen in the tall trees that stretched up through the lower tangle of bushes. We did secure a couple of each, though. Later, while we were enjoying some juicy oranges at the base of the tree from which the guide had dropped them, we noticed a good-sized wild pig walk out of the brush a hundred yards below us. It had evidently heard the oranges drop to the ground and had taken the thuds as a signal not to be disregarded if other pigs were in the vicinity. It gazed up toward us while we kept perfectly still and then it started walking slowly up through the brush. I quickly changed the charges of small shot for two number sixes and, when the pig had approached sufficiently close, fired one barrel of the twenty gauge which was as effective as a rifle ball would have been.

Tafia, all smiles, at once began to break up sticks and limbs, and piling them carefully together, fired the heap; after which he enclosed the fire with large lava chunks and, as the fire began to burn well, piled still more rocks on the burning mass. In about ten minutes conditions seemed to be to his liking, so he took the porker and began pulling one side of the body rhythmically back and forth over the heated rocks. In a short time clear, clean patches began to appear on the scraped surface, and a few deft pulls with his fingers under the legs and about the ears completed the depilating process on one half the beast. He then repeated the process on the other side. We were astonished at the ease with which a dirty, bristly, brindle pig had become a clean, smooth, white-skinned, although skinny hog. In less than half an hour from the time the pig walked up to us we were walking away campward with his clean, bristleless body.

Since Tafia had shown such skill and proficiency in removing the hirsute covering of our prey, we decided to let him cook it also Tahitian style. The meat was thoroughly washed and cut into convenient pieces; then these were placed on a layer of thick, green leaves that covered a pile of rocks which had been heating for some time. Another layer of leaves was laid over the meat and the whole covered with rocks. When supper-time arrived, we uncovered the mound and took out the appetizing food. After we had eaten the choicest of the best cooked portions, the remainder was carefully cut from the bones and rammed into three large, green bamboo joints, which were placed on the still hot rocks, covered again with leaves, and taken out the next morning, deliciously cooked, to furnish the party with rations for the next three days. Fireless cookers as fabricated by several American manufacturers may produce edible and economically cooked results, but for thoroughly toothsome and exquisitely flavored pork preparations, Tafia's cane and lava method is hard to excel.

Our next camp, built against a great overhanging bowlder and well roofed with the leaves of a mountain tuber, was not altogether proof against the tropical downpour that assailed us during our first night under it. First in one spot and then another the dripping drops would strike us: a shift of position would be made and then we would wait for the next assault. The little brook, twenty feet below us, that dropped in tiny rapids and waterfalls from one shallow pool to another, changed its placid murmur to a lusty rumble as it rolled rocks along its bed and poured downward the heavy volume of water that the cañon above was shedding.

A sunny morning cleared the water from the leaves, but our search for birds was again disappointing. Two or three swallows flying back and forth in the dark shade of a dozen orange trees, a couple of noisy broad-billed kingfishers flying out after insects instead of perching over the water to watch for finny prey, and companies of boisterous, rollicking minas (a robin-like species introduced from Australia) comprise the birds seen during the day. This negligible number of native birds in so seemingly favorable an environment was something new in my experience. One could hardly believe that the rats, which were such a pest in the lower parts of the island, had destroyed all the nests of certain native birds while permitting the imported minas and weaver birds to increase. It seems more likely that cats, running wild for a hundred years or more, may have exterminated three or four of the ground-loving species that were formerly found here.

As our guides had assured us they knew where shearwaters nested close under the cliffs near the highest peaks, we continued our march inland and upward. The trail led past well laden orange and lemon trees, growing singly and in groups, beneath which could be seen the tracks of wild pigs that had been looking for fallen fruit, although for the lemons they seemed to have no liking. We camped quite near the Diadem, one of the best known peaks of the island, and our camp here, at

2700 feet, was covered with leaves of the *fei* or wild banana plant which grew by the hundreds in the immediate vicinity. We noted less than a dozen ripe bunches of the fruit, and on inquiry we learned that the place was regularly visited and the bunches, containing about fifty bananas, each valued at ten francs, were taken and carried on poles down the ten-mile trail to the mouth of the cañon, where other means of conveyance was waiting.

A two days' search of mountain- and cliff-sides, where the rope, more than once, was necessary to the safety of the party, revealed only a dozen deserted burrows of the hoped for ocean birds, although one of the handsome, long-tailed tropic birds was flushed from an unapproachable hole in the cliffs.

Leaving our unprofitable camp under the Diadem, we hiked out again down a steep, sharp ridge into a little cañon leading into the main watercourse which headed near by on the sides of Mt. Orohena, the highest peak in the Society Islands.

A band of wild pigs jumped out of canebrake in the bottom of the cool cañon close by the running water, but our guns, empty for safety's sake, did not hinder their hurried flight. Following down the brawling water, we soon came to a rock-bound waterfall; here it became necessary to scale the steep bank and climb out over a spur that ran down between the converging streams. We were surprised to find an acre or two of level land on top of the spur, and still more surprised to be told that the large rock-built square which we noted had formerly been a place where ceremonial dances and other impressive rites were performed. A more unlikely place from a present-day point of view would be hard to select, but when the mountains teemed with inhabitants, it may have been quite centrally located.

We skirted along the side of the spur and gradually dropped down into the main stream of the Punaruu; crossing it, we climbed up past a great clump of bamboo to an old camp site where we had a fine outlook over the greater part of the plateau below us.

Here our camp, built once more in the rain, was roofed over with the broad-fronded leaves of a heavy fern, thick clumps of which were scattered about in the underbrush. The next day one of us worked up from this point to the top of the ridge, while the other worked up the stream through canebrakes and along pig trails to the wildest part of the region. Neither of us saw other native birds than the dove, swallow, and kingfisher. To myself, returning to camp in the afternoon with a single dove after hours of hunting, the contrast between bird life on this island and that of another island in the same southern Pacific Ocean (Indefatigable, of the Galápagos group, where, with nothing but lava rocks thrown by hand, I had secured for food more than forty doves in two hours) was startling, even though easily explainable by the different conditions under which the birds lived.

Having completed our reconnaissance of this section of the island, we packed up the next morning and started downward. We reached the motor road by the beach at five o'clock in the evening and our cottage somewhat later, as it was necessary to telephone from a plantation near by to Papeete for an automobile to run out for us.

To the ornithologist the trip was unsatisfactory, but to a lover of rough, tropical mountain scenery the same route can be highly recommended.

UNUSUAL PHOTOGRAPHS OF FISHES

BY ELWIN R. SANBORN

Photographer for the New York Zoölogical Society

Photograph by Elwin R. Sanborn

SQUIRREL FISHES

Obtaining satisfactory photographs of fishes under water, even in a tank, is a matter of great difficulty on account of the very unsatisfactory light. Mr. Sanborn has solved the problem in a series of beautiful pictures of the fishes at the New York Aquarium. Here we see a school of bright red squirrel fishes (*Holocentrus ascensionis*) hiding in a submarine crevice, just as they would be likely to do on their native tropical reef, until in the failing light of evening (approximating that to which their deeper-water relatives are accustomed) they come out in search of food

Photograph by Elwin R. Sanborn

ROCKFISH, GROUPERS, AND JEWFISH

The Serranidæ or sea bass family is represented southward by a great variety of species. Some of these, known as rockfish, groupers, and jewfish, reach a large size. The two big fellows in the picture are groupers (*Epinephelus*). The one resting on the bottom to the left is a spotted jewfish (*Promicrops*), a baby of its kind. There is a record of a jewfish of 400 pounds taken with rod and reel. To the right and above are rockfish (*Mycteroperca*). Such fishes are more or less solitary and sedentary in habit, although sometimes associated in considerable numbers about some favorite ledge down in the cool shadows under the blue-green water

Photograph by Elwin R. Sanborn

AN ASSEMBLAGE OF TROPICAL FISHES

Nowhere in the sea does one find such variety of fish life as about a tropical reef. This tank of fishes at the New York Aquarium will give some idea of conditions to be met with there. At the top of the picture in the center one can recognize the queen trigger fish (*Balistes vetula*). At the right a boldly banded spadefish (*Chaetodipterus faber*) stands out against the shadow. Immediately below it two or three porkfishes (*Anisotremus virginicus*) swimming close to the bottom are readily distinguished by their striking livery, banded in front and striped behind. In the center of the picture two pale-colored members of the Crevally family (*Caranx crysos*) are facing each other and the camera obliquely. Immediately below the left-hand one, the dark fish with a white mouth is one of the black angel fish (*Pomacanthus*). Above it is a grunt and above that two squirrel fish. On the bottom several rock hinds (*Epinephelus adscensionis*) are resting in the foreground. It is possible to pick out still other varieties, but a photograph, of course, gives little more than a suggestion of the beauty and variety of color in these forms

RAINBOW NATURAL BRIDGE LOOKING SOUTH–NAVAHO MOUNTAIN IN THE DISTANCE

Midway between the figure of the man at the left and the arch is an Indian prayer shrine—upright stones around a flat stone in the center—and a similar shrine is on the opposite side of the creek just beyond the dark rock in the centrai part of the picture

From Kayenta to Rainbow Bridge

By CHARLES L. BERNHEIMER

NOTE.—In the spring and summer of 1920 Mr. Bernheimer visited the little known Rainbow Bridge in southern Utah. In his letters he relates some of his experiences on the trip and describes briefly the natural beauties of the region as well as the difficulties and dangers attending the traveler who would journey through that rough and inhospitable country.

KITSIEL RUIN, Sagie Cañon, Arizona, May 17.—I wrote you yesterday before I left Kayenta for the journey to Rainbow Bridge. We made only fourteen miles that day,—eight by automobile, the remainder on horseback,—and slept last night at Laguna Creek in Sagie Cañon. The weather turned very cold and my woolen nightcap was much needed, but I awoke with the sun, crisp and lively as a young cricket.

We started at a quarter before eight this morning and rode until nearly three with only about an hour's intermission, during which we visited the Betatakin Ruins. They were wonderful! To do this we had to run into one of the many side cañons opening into the Sagie, entailing about five miles' extra travel, but I cannot tell you how glorious these intricate, lacerated arteries are, which sand storms, creeks, snows and windstorms, frost and heat, have cut into this bleak part of the earth's crust.

We continued our ascent in the Sagie, then entered another side cañon and arrived at the foot of the Kitsiel Ruin, which in Navaho language means "much pottery." The valley is about one quarter of a mile wide, flat, but cut up by forty- to fifty-foot "washes" in which a confluent of Laguna Creek creeps. Such washes we had to cross dozens of times on our way here. We could not travel in the creek itself because of the many places in it which were jelly-like quicksand. To get to the Kitsiel Ruin I had to be helped by my three guides with a rope securely tied about my waist,—two of the men held the rope above and one climbed along with me, placing my feet. There was no risk whatever with the three experts watching over me, and the feat was worth all the trouble. I had to get down the "wash" of the creek, which here is about fifty feet deep, with the bank at an angle of 80 degrees,—practically perpendicular. This was a new experience. Johnson said: "Just sit down at the edge, dangle the legs over, the bank will break, and you will slide down with the sand as softly as if you were in a feather bed." I did, and it was a "peachy" yet novel toboggan slide.

The ruins are extraordinarily fine—equal to any of those at Mesa Verde. Some of the houses are in perfect condition. The finger marks of the builders, made more than one thousand years ago, are evident everywhere in the plaster or mortar. The cedar beams, the floors or roofs built of cedar, rushes bound in with willow branches, parts of woven baskets, are just as they were left when the people departed.

I have never fully described my outfit to you. There are eleven animals in all, six horses and five mules. My guides are John Wetherill, Ezekiel Johnson, and Al Smith, one of Wetherill's helpers, a nineteen-year-old, strong cow-puncher, cook, athlete, and general good all-round man. We have plenty of trouble with our animals, and there is a real western scene when they have to be rounded up, roped, and dragged at times when they become unusually

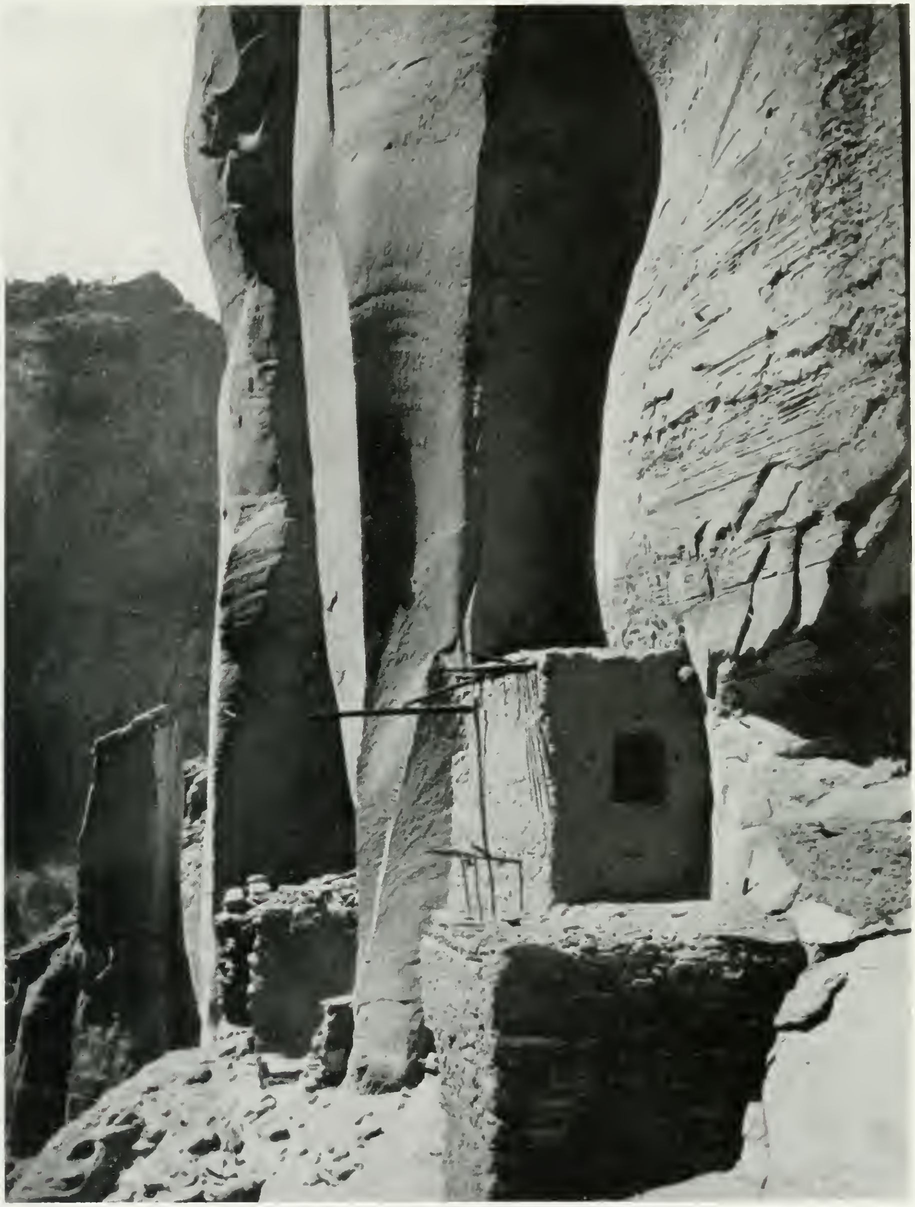
Center portion of Betatakin Ruins—one hundred feet above the bottom of the cañon. The beams and lumber are the remains of dwellings that have crumpled away

headstrong. The animals slip their loads very often by knocking against tree branches, rocks, and one another. At other times they lie down, load and all, preferably in a stream of water.

May 18.—After a more or less restless night we started from Kitsiel a little before eight on the way to Piute Cañon, which we hope to reach late this afternoon, and which we shall cross at the upper crossing tomorrow. After we climbed out of Laguna Cañon, much of our travel up to noon, when we stopped for lunch near Bubbling Spring, was over slick rocks. No doubt I shall use the words "slick rocks" often, and as these rocks are our chief trouble, I shall describe them. Winds and storms and sand blasts have cleared the rocks of all earth and polished them, and the horses slip easily on them; besides, they are of a limestone substance which, somewhat harder compared with the red sandstone generally met with, offers to the horses an insecure footing. The faithful brutes know this and it is pathetic to see how they watch their steps.

Evening.—We did not reach Piute Cañon. After making twenty-one miles since this morning we took advantage of a little cove in a mesa at the end of which Wetherill said there was a spring. The mouth of this cove was closed by sand dunes, which sooner or later will choke the little spring and kill, as they have already far progressed in doing, cedars and service-berry trees and scrub oak. Of course, by "spring" you must not understand the babbling kind,—it is merely a crevice in the rock out of which oozes a cupful of water every five minutes, which, if collected in pools near by, offers all we need. We named this spot "Hawk's Nest Cove," because of a hawk that was nesting above us. Hundreds of birds,—robins, bluebirds, and doves,—flew in at sundown to drink at the spring. The hawk did not have to go far for his supplies.

May 19.—We left camp this morning about eight o'clock and traveled the remaining five miles to Piute Cañon, walking down part of the way and leading our horses where the rocks were too



THE WESTERLY EDGE OF BETATAKIN RUINS

Emblem of the War God of the Navahos on the sandstone rock wall near the easterly end of Betatakin Ruins

helter-skelter for complete safety. On the other side of the cañon the ascent was similar, and we had to use all necessary precautions. That others had not done so was evidenced by the skeleton of a horse on a rock which our trail skirted.

We stopped on top of a low mesa in full sight of Navaho Mountain. Man and beast had to get along without water. Our lunch consisted of raw canned tomatoes (which are perfect thirst-quenchers when there is no water to be had), a can of pears, and some slices of stale bread. Late in the afternoon we began to climb Navaho Mountain, our intention being to stop from May 19 to 21 on a "bench" on its south slope about 1500 feet under its summit. The slope is covered with yellow pine, cedar, piñon pine, and quaking aspen. The mountain is 10,622 feet high and, you may remember, could well be seen from "Desert View," where we went by automobile from El Tovar on the Grand Cañon. Our camp was made near "War God Spring."

May 20.—This morning we started up the remaining 1500 feet,—we rode on horseback about 500 feet and then walked. The tramp or climb, at no time dangerous, was made exceedingly wearisome and trying by the fact that, unknown to Mr. Wetherill, the top of the mountain was covered with snow,—melting in rivulets and pools,—and almost every minute we waded and sank into snowdrifts above our knees and often up to our hips.

The view from the top of Navaho extends two hundred miles in all directions. We can see from there a great portion of four states, and the contrast from the desert floor to the slope of this noble mountain which is sacred to the Navahos and which they do not ever ascend, as they hold it in awe and believe it inhabited by one of their gods, is truly great. Because of the red rocks all over, the yellow desert sands, the sage flats and dark purple shadows, and the peculiar atmosphere, the panorama was a huge sunset-like expanse in rainbow colors. The sage brush of Arizona suddenly gives way to Oregon pine on the slope of Navaho. These fine, yellow pine trees here reach a height of two hundred feet and are often six feet in diameter and as straight as flagpoles, and the forests are virgin.

May 21.—We started this morning in the rain and toward noon came to country rougher and more picturesque. Surprise Valley is a real paradise. The approach to this marvelous little oasis is by a narrow cleft in the rocks. It cannot be reached from civilization by any other way, and the difficulties one must overcome to get there are unusual and most trying. For instance, we were one hour on whaleback, bare, slick rocks; at first sight it seemed impossible to cross them. Imagine smooth rocks, each a couple of acres in extent (exactly like a whale's back) which you must cross endlessly one after another. After these have been passed and just before one gets to the small, narrow gateway, there is a fiendish place to come down. How horses can do this I don't know, but our eleven animals did it safely.

May 22.—At noon sharp we reached Rainbow Bridge. I had often thought of it,—pictured it,—yet all my expectations are surpassed! It is more graceful, yet more powerful and more perfectly symmetrical than in any photographs I have ever seen, and it is worth all the trouble necessary to reach it. First the journey was merely an endurance test, but during the last two days it was all of that, plus skill (if I may use this word for myself) and instinctive ability on the part of the horse,—and fearlessness all around. The latter, after many days of preparation, becomes almost second nature.

The approach to the bridge,—that is, practically the entire nine or ten miles from Surprise Valley until the bridge is reached,—is a round of surprises. Bridge Cañon (which the Rainbow Bridge spans) is for several miles one continuous, awe-inspiring series of deep caverns. These concave places are about two hundred feet deep and three hundred feet at their openings, and when they occur on both sides, the effect is as though one were walking or riding in the inside of a sphere with but a slit left open above for the sky.

A more inspiring natural thing than the Rainbow Arch I have never seen, and it can be compared only with such wonders as the Grand Cañon. The dimensions are 309 feet in the clear from the bottom of the cañon and 277 feet from pier to pier! Its real name—in the Navaho language—is Nodzealid, which means rainbow. The Navaho name for Surprise Valley is Nasja, or in English, owl, and that was the name of the friendly Indian who first told Mrs. Wetherill of the existence of this place, which to the Indians is sacred, and no wonder. Mr. Wetherill, Professor Cummings, and a Mr. Douglas, under the former's leadership, got here in 1909. How they ever did it is a marvel of desert-craft, for the chances for mistakes, costly in time, fatal to provisions and horses and men, were ever present.

We are camping right under the arch of the Rainbow Bridge and the rock I am sitting on is directly under its keystone (if it has any). The air is warm and balmy, and desert flowers (mostly modifications of our home flowers) are all around me, growing out of the crevices in the rocks. Under

RAINBOW NATURAL BRIDGE LOOKING NORTH—BRIDGE CREEK BED IN THE FOREGROUND

Note the atmospheric conditions as illustrated by the fact that there is a distance of a quarter of a mile between the bulging rock in the foreground at the right and the one which appears to be directly behind it but which in reality is on the other side of the bridge. Compare with view of bridge looking south, page 552

the ledges of rock in the river bed we found the most beautiful maidenhair fern jardinières I ever saw; then we found a wild species of orchid (green and pink), and hanging on to one we found the nest of a humming bird. Upon looking into the nest (it was not bigger than a plum), we saw two little mouths open,—the baby humming birds had taken us for their parents; the little birds were each about as large as a bumblebee.

In this cañon there are more varieties of plants and flowers than are to be found between Asbury Park and New York City, and their blossoms are exquisite. There is, for instance, the yellow flowering, highly scented greasebush at my feet; it looks like a heather but is immeasurably more beautiful; there is the Indian paintbrush, a bright scarlet flower, so brilliant it can be seen two hundred feet away; there are acres of these, and no end of columbines, deep blue, light blue, and variegated, the beautiful but dreaded loco, daisies of all kinds, yuccas, purple wild asters, yellow sunflowers in profusion,—two scarlet spiked plants, one unnamed, the other called "standing cypress," while the cacti are simply dazzling,—orange, lemon, brick-red, baby-pink, magenta, and other colors, while the texture of the petals is as delicate as the film-like mull skirt of the *première danseuse* at the Grand Opera. The sago lily (Mariposa lily) found here grows in four colors and all intermediate shades,—they are white, golden, pink, and lavender (Mariposa is the Spanish word for butterfly, and they do look like butterflies). We passed the real purple sage yesterday. I cannot tell you how delighted I was to see it, for I really thought there was no such thing,—merely a poetic license. It is all different from the well-known desert sage. It has a blossom of deep royal purple of unusual intenseness; in the bright sun the blossom looks almost black. The horses love to browse on it. Our mute, intelligent animals are wonderful botanists,—they know exactly what is proper and wholesome food, and what to leave alone. And how sure-footed, fearless, and faithful! How impossible life would be in these trackless wastes and far reaches without them. That applies equally to the most low-bred Indian mustang. We have one they call "Bridget-Jack,"—a gray-bearded, hammer-headed, small animal. She is surly and difficult to handle, never seems to respond to kindness, but she is sure-footed and safe and attends to her duty, and carries, without a grunt, the heaviest load.

We have not been bothered by any insects excepting mosquitoes in our camp on the slope of Navaho Mountain, and their sting is not as venomous as that of the Jersey variety.

May 24.—We slept for a second night under the bridge and left for home today. Our load being lighter,—fodder and food having been consumed,—we could now travel more rapidly or in longer day marches.

May 25.—Our camp last night was on the northeast slope of Navaho Mountain. We had to trail around its rocky sides and finally at half past nine in the morning we reached the open, flat desert.

May 26.—We arrived at Kayenta at five o'clock in the afternoon, thus ending a delightful, happy, instructive expedition, which the good Almighty allowed to pass safely and without the least mishap.

THE MERMAID'S WINEGLASS, *Acetabulum crenulatum*, an exquisite green seaweed, photographed (natural size) soon after being taken from the waters of Biscayne Bay at Miami, Florida. This dainty plant is of occasional occurrence in shallow bays of Bermuda, southern Florida, and the West Indian islands. In Biscayne Bay it sometimes covers areas of considerable size to the exclusion of nearly all other kinds of marine vegetation. The elegant, radiately chambered cups are bright green when living, but they have a delicate coating of lime and they usually become chalky white soon after being gathered

Some Plants from Tropical Sea Gardens

By MARSHALL AVERY HOWE

Curator of the Museums and Herbarium of the New York Botanical Garden

A VISITOR from the north is often disappointed by his first sight of a tropical strand, which commonly shows little or no conspicuous vegetation between the tide lines. Particularly is this true if he is familiar with the rocky coasts of northern New England, where a large share of the richly abundant marine plant life is exposed freely to view with every ebbing tide. Probably the usual poverty of the strictly littoral marine flora in the tropics is due chiefly to the scorching effects of the tropical sunshine, although there are, of course, here as elsewhere, numerous more or less wide areas where a bottom of loose shifting sand, allowing no stable foothold or anchorage, precludes the development of any conspicuous vegetation.

But there are also extensive rocky shores, submerged reefs, and bottoms strewn with old corals or calcareous pebbles, where light, heat, aëration, and suitable anchorage combine to furnish ideal conditions for the development of marine gardens. If the observer can wade into such a place at low tide, especially on a calm morning before the daily trade wind arises to ruffle the surface of the water, the sight is one that is long to be remembered. Or perhaps he can row over it on one of the calm days such as occasionally occur in late spring or in summer, or can view it even in less placid weather from a glass-bottomed boat at some winter resort.

In addition to the graceful, often brilliantly colored or iridescent algæ—the plants proper—there are commonly also in such a garden stately corals and sea fans, which are colonial animals. These animals, because they are attached and have no more power of locomotion than a tree, are ordinarily looked upon as plants by the uninitiated. In fact, the "sea gardens" that are exhibited through glass-bottomed boats to patrons of southern winter resorts are sometimes almost exclusively "zoölogical gardens." Besides the colonial animals firmly attached to the home spot there are often also gaily colored tropical fish swimming in and out among the other organisms and giving a touch of active life to these submarine beauty spots.

Although the adjective "tropical" is used in our title and elsewhere in this discussion, the wealth of the marine vegetation in the subtropics of our North American coasts and adjacent islands is probably even greater than that of the tropics, strictly speaking. In respect to number and variety of species of "seaweeds" or algæ the richest areas in the northern half of the western hemisphere—at least the richest visited by the writer—would appear to be Bermuda, the Florida Keys, and the coast of California. It is possible, however, that Guadeloupe,[1] wholly within the tropics, deserves to be considered in this connection. Parts of the Bahamas, of Cuba, Jamaica, and Porto Rico, and of the Caribbean coasts of Panama are well supplied with marine algæ, but, taken as a whole, they do not give the collector the impression of wealth that he obtains from prowling about in the waters of the Florida Keys and Bermuda.

The "Sargasso Sea," in any such magnitude and character as was described by some of the early navigators and as was represented on some of the maps made only fifty years ago, seems to be more or less of a myth. Yet, floating mats[2] of *Sargassum*, several feet or, rarely, several rods in width are frequently met with, as one steams southward from New York or Halifax, or cruises about among the West Indian islands. Floating *Sargassum* is found particularly in the path of the Gulf Stream, which sometimes brings it far to the north, occasionally casting it ashore after

[1] The algal flora of this island has been intensively studied by French scientists and the list of marine species and varieties attributed to it reaches the imposing total of 811, a number considerably greater than that thus far attributed in any published paper to any of the three other regions. The determinations on which the Guadeloupe list is based are not altogether critical, however, and the sum total is swollen by the inclusion of numerous varietal or form names.

[2] These mats consist chiefly of two species, *Sargassum natans* and *S. fluitans*, which are certainly known only in a free floating condition.

THE MERMAN'S SHAVING BRUSH, *Penicillus capitatus*, from Bermuda. (About one half natural size)

a storm on Long Island, Martha's Vineyard, and Nantucket. As is well known, it is accompanied by a characteristic fauna of bryozoa, crustaceans, small mollusks, and the like, and fishes which go along with it to feed on the small animals that it carries. Species of *Sargassum* are difficult to limit and define, but it is safe to say that a dozen or more occur in the West Indian region. Most of these are surf plants, growing firmly attached to rocks and reefs in exposed places. They are found near the low-water mark, and, with their cousins of the genus *Turbinaria*, they take the place, in the south, of the northern rockweeds of the genera *Fucus* and *Ascophyllum*, both taxonomically and ecologically, although never so conspicuous and massive as the latter often are.

The genus *Sargassum*, like all the other algæ, belongs to the large group of plants known in the books as "thallophytes"—a group in which the plant body, according to the bookmakers, is not differentiated into root, stem, and leaf; yet it is very difficult, if not impossible, to frame a definition of a leaf which may not apply to the leaflike structures shown by the species of *Sargassum*. In other words, a *Sargassum* is a "leafless" plant that appears to have leaves.

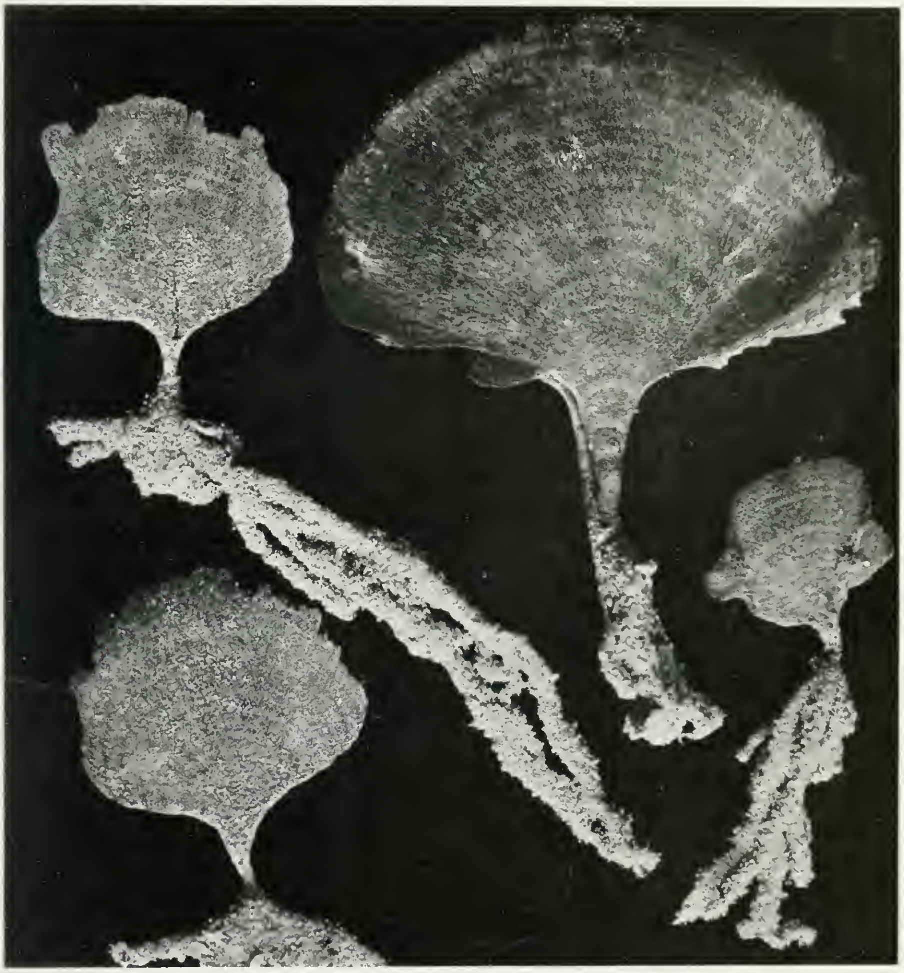
The larger algæ are divided into three great groups, which are often spoken of in an untechnical way as the "greens," the "browns," and the "reds," these names being abbreviated translations of the technical group names, which have been based upon the prevalent colors shown by representatives of these groups. The "browns" include the largest kinds of seaweeds, such as the kelps and rockweeds of the North Atlantic and the giant kelps of our Pacific coast, individuals of which often reach a length of more than one hundred feet and the extensive beds of which are now being used as a source of potash for the American farmer and gardener. In the American tropics, the more conspicuous members of the brown group include, besides *Sargassum* and *Turbinaria*, already mentioned, representatives of several other genera.

It is perhaps in the large group of algæ known colloquially as the "greens" that one finds the most interesting and curious as well as the most beautiful of the tropical sea plants. In these, the leaf-green or chlorophyll, characteristic of plants in general, is found essentially free from admixture with other pigments. In many of them, however, the plant body is more or less coated or permeated with lime, so that it is often whitish, at least in the older parts, or speedily becomes so after being taken from the water and exposed to the light.

Of the group of calcified green algæ the four species of *Penicillus*, indigenous to the sea bottoms of Bermuda, southern Florida, and the West Indies, are among the most curious. In these, as is suggested by the Latin name, the plant body takes the form of a brush, its component filaments being closely interwoven to make a cylindric or flattened stalk and then, at the top, set free and forking, each enclosed in a porous sheath of lime, they constitute the head or bristles of the brush. One sort, perhaps the commonest, is sometimes known as the merman's shaving brush, or is occasionally referred to by the less particular and meticulous as the mermaid's shaving brush.

A relative of the plant just described and one that grows in similar situations is the mermaid's fan. There are several species of this generic group (*Udotea*), in all of which the delicate root hairs penetrate the calcareous sand and attach to themselves small particles of this sand, thus making anchorage hawsers in a bottom that is not altogether stable. The rootlike part, in the attached algæ, is supposed to serve simply as a holdfast. These sea plants often affix themselves to smooth hard rock, or sometimes to pieces of iron or glass, from which they can evidently draw little or nothing in the way of nourishment. Their food is apparently derived directly from the surrounding water and air and is taken in directly by the general surface of the plant. In the case of these Udoteas and their relatives, however, with their highly developed systems of sand-burrowing rhizoids, it may be suspected that these rhizoids play a part in the gathering of food as well as in anchoring the plant. What are commonly called "sea fans" by frequenters of the sea are organisms of a very different nature from those here described under the name of mermaid's fan. They are larger and are colonial animals related to the corals.

Another interesting and attractive member of the group of lime coated green algæ is the sea fir (*Rhipocephalus phœnix*), the center of whose distribution appears to be the Bahama Banks. This plant is usually from two to six inches high and when growing on the sea bottom is very suggestive of the little German Christmas trees that were



THE MERMAID'S FAN, *Udotea conglutina*, from Bimini Harbor, Bahama Islands. (Natural size)

A CALCIFIED AND SEGMENTED GREEN SEAWEED, *Halimeda simulans*, from Porto Rico. (About four fifths natural size)

once sold in this country for holiday decorations. It is dark green when living but is soon bleached to a chalky white after being killed and exposed to the light. In general structure, it is somewhat intermediate between the brushes and the fans, being brushlike in general habit but having numerous small overlapping fans for branches.

The writer once enjoyed the privilege of being becalmed for two days on the Bahama Banks in a small sloop. On these banks are hundreds of square miles where the water is mostly from one to twenty feet deep. The bottom here is chiefly of more or less compacted oölitic sand, consisting of clean white nearly spherical granules that suggest fish roe both in form and size. Such a bottom rarely becomes muddy to any appreciable extent and the waters above it are wonderfully clear, so much so that when a breathless calm makes the surface of mirror-like smoothness one can see the vegetation and animal life of the sea bottom in twelve or twenty feet of water almost as distinctly as if the water were only two feet deep. On wide areas of the Bahama Banks the merman's shaving brushes, the mermaid's fans, the sea firs, and their relatives are the dominant features of the marine flora, sometimes forming a continuous carpet on the floor of the sea.

Prominent among the relatives of the Udoteas are eight or ten kinds of *Halimeda*, in all of which the calcified plant body is regularly jointed or segmented. In most of the species of this genus the lime is abundant and the system of joints gives a certain degree of flexibility to a plant that would otherwise be quite rigid and stonelike. One of the species, at least, sometimes occurs in great masses, and the quantities of lime left by its decay are, in places, important factors in reef building and land forming. The fact that it is a more rapid grower than the corals seems to give it a certain advantage over them in the matter of secreting and depositing lime, even though the proportion of lime in its make-up is not so great.

Perhaps the most dainty and exquisite of the green algæ is the mermaid's wineglass, *Acetabulum crenulatum*, which grows in shallow bays and protected places, ranging as far north as Bermuda and southern Florida. It is rarely found in any great quantity, yet occurs in considerable abundance on old shells and pebbles, mostly in ten or fifteen feet of water or less, in the bays lying between the keys and mainland of southern Florida. The actual height of the plants is usually from two to four inches. The elegant cup-shaped disk which surmounts the graceful stalk is largely reproductive in function, each of its radial chambers containing at maturity, in the present species, from 200 to 500 subglobose, firm-walled spores, scarcely visible to the unaided eye, each of which produces on germination a number of smaller motile cells which are sexual in nature. At least three other species of this genus occur in the West Indian region.

Among the larger green seaweeds of the warmer parts of the earth are some that are not calcified and of these the species of *Caulerpa*—a dozen or more of them in Bermuda, southern Florida, and the West Indies—deserve especial mention. These present themselves in a great variety of graceful and attractive forms, some of them suggesting delicate feathers, others looking like clusters of green grapes, the inflorescence of grasses, the twigs of cypress trees, or sprays of running pine. They are found in tide pools, on the roots of the red mangrove in lagoons, and creeping on the sea bottom down to a depth of a hundred feet or more. Individual plants of some of the kinds get to be four or five feet long. A curious thing about them is that, although they are plants of considerable size, no one has yet certainly detected in them any spores or other special reproductive organs. They seem to maintain themselves by simply continuing to grow at one end while dying off at the other, or to propagate their kind by accidentally detached fragments. It nevertheless seems probable that they produce some sort of minute reproductive cells which have thus far escaped observation and detailed description. Doubtless much remains to be learned about the life history of the Caulerpas and many of their relatives by some one so situated that he can watch the living plants continuously throughout the year, with a compound microscope and needed accessories at hand.

A species of *Valonia*, taking the form of a

A GREEN SEAWEED, *Caulerpa racemosa*, that suggests bunches of grapes, photographed (not in place) at the mouth of the Guánica Harbor, Porto Rico. (About one half natural size) balloon or an irregularly oval sac, ranging in size from the dimensions of a robin's egg to those of a hen's egg, and filled with a fluid protoplasm, is often found washed up on beaches in the West Indian region and is, in Bermuda at least, often referred to as "sea bottles." Dark green and iridescent in life, it becomes clear and translucent after being killed and exposed to the light for a time and may be as attractive then as when living. Children sometimes pick it up on the beaches and by skilfully exerted pressure playfully squirt the liquid contents into each other's faces. These little "bottles" grow in shallow water mixed in with seaweeds of the soft mossy kinds or under shelving rocks near the low-water line. Another kind of *Valonia*, consisting of somewhat smaller ovoid or bottle-shaped segments that branch and cohere in large masses, is often beautifully iridescent and very attractive when seen growing in the water.

It is in the large group of marine plants known nontechnically as the red algæ that we find the greatest variety in the tropics, although as individuals the "reds" are rarely so numerous or so conspicuous as are many of the "browns" and "greens." Many of the most interesting and beautiful of the "reds" are so small that their wondrous symmetry and beauty are revealed only to the user of a hand lens or a compound microscope. Several are so delicate or have such a soft gelatinous texture that when floated out on paper and dried under pressure they adhere so closely to the paper and have so little substance that they are sometimes taken for paintings by those who do not stop to realize that no human hand could trace lines of such delicacy and symmetry as these "flowers of the sea" often possess. One of the coarser red seaweeds of the tropics, *Bryothamnium triquetrum*, looks a little more like some land plants. The main axes have three rows of short toothed or fringed branchlets, giving these axes a three-angled or three-winged effect. The individual plants form dense clumps one or two feet in thickness, but they sometimes grow associated in large numbers, forming extensive beds.

The red algæ, like the greens and the browns, contain chlorophyll, the green color substance common to plants in general, but they have also another pigment that modifies or obscures the green, so that the plants appear to be of some shade of red, pink, or purple, or sometimes almost black. The red pigment is soluble in fresh water, and the green is not, so that red seaweeds washed up on the beach and exposed to rain often become green or show zones or spots of green in the more exposed parts. On the other hand, the green is soluble in alcohol while the red is not, so that the two pigments may be easily separated. The red algæ that are really and strikingly red are, with few exceptions, inhabitants of deeper water than the greens and the browns and are usually collected by dredging—or by being found washed ashore, particularly after a storm.

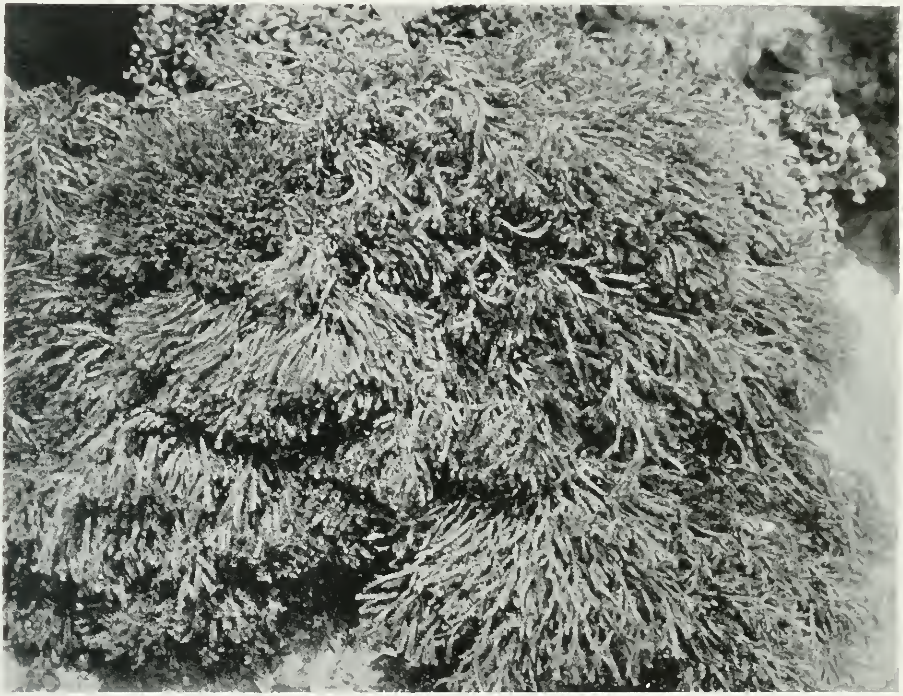
Several kinds of red algæ as well as of "browns" are extensively used by the Chinese and Japanese as articles of food.[1] The agar-agar of commerce, derived from red algæ, is a food in the Orient, but is known in America best as a nutrient medium for laboratory cultures of bacteria and fungi. Another product of red seaweeds, known as "funori," is manufactured by the Japanese to the amount of two or three million pounds a year and is used by them for sizing for cloth, for which purpose it seems to have certain advantages over starch. Most of these marine algæ from which the Japanese derive products that sell for several millions of dollars a year have close relatives in American waters, but apart from the recent development of the kelp potash industry in California and the use of seaweeds as a fertilizer for the land by farmers living in the vicinity of the sea, the inhabitants of the United States have thus far made little practical use of the plant life of the ocean.

On the coast of Massachusetts the Irish moss or carrageen (*Chondrus crispus*) used for making sea-moss jellies or puddings, is collected to the value of a few thousand dollars a year, and the "dulse" (*Rhodymenia palmata*), which is eaten raw as a sort of salad or relish, is gathered in still smaller quantities and offered for sale

[1] See paper, by the writer, on "Some Economic Uses and Possibilities of the Seaweeds." *Journal of the New York Botanical Garden*, XVIII, 1917, pp. 1–15.

in the water-front markets of New York and Boston. But with the increase of the population of our country, and with the certain advance of science and its applications, it is probable that the future will witness a widely extended utilization of the plant resources of the sea.

In at least three of the natural families of the red algæ the plant body takes up lime from the sea water and becomes more animals, even though, as would now appear, these coral animals are often of secondary importance. But the coral-like seaweeds are always plants, however coral-like they may look. In microscopic structure and modes of reproduction they are just as truly plants as are any of the seaweeds of the soft mossy kinds. Yet it is not at all surprising that those who have not studied such things sometimes confuse these hard

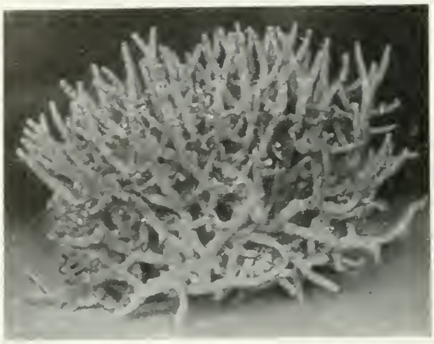


A LARGE RED SEAWEED, *Bryothamnium triquetrum*, of the American tropics and subtropics. photographed (not in place) at the mouth of Guánica Harbor, Porto Rico. (About one third natural size.) At Key West, Florida, this species forms large mats on the floor of the ocean, mostly at a depth of from twenty to fifty feet

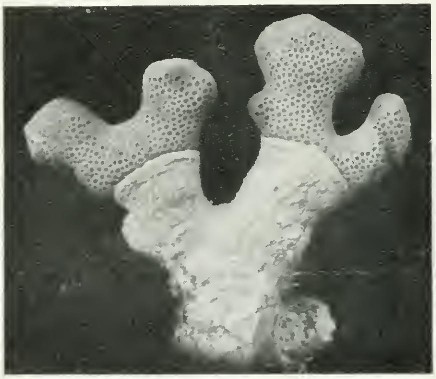
or less hard and stonelike. In one of these families in particular (the Corallinaceæ, so called on account of a superficial resemblance to the corals) the plant, except for the inconspicuous reproductive cells and almost equally inconspicuous apical or superficial layers of new tissue, is almost as hard as any limestone rock. It has become apparent in recent years that in many parts of the world these lime-secreting sea plants are and have been an important factor in the building of reefs, a line of activity that in the past has been attributed almost exclusively to the coral

stonelike plants with the corals and that even the naturalists of a hundred years ago often did likewise.

The lime-secreting plant often forms a crust that gradually creeps over, covers, and smothers coral animals. Plant crusts of these kinds are usually small and thin and are probably of not much importance in building reefs. But there are many different kinds of these hard lime-secreting plants and some of them occur in large masses and form extensive reefs. Certain species are of a delicate pink color, so that one may easily imagine what an attractive



ONE OF THE STONY, LIME-SECRETING CORAL-LIKE SEA PLANTS, *Goniolithon strictum*, from Key West, Florida. (About one half natural size)



AN ENCRUSTING SEAWEED, *Goniolithon solubile*, growing on a living coral, from Porto Rico. (About two thirds natural size.) The lime-secreting plant is conquering the lime-secreting colonial animal, gradually covering and smothering the coral polyps

display a reef must make when exposed, or even when visible through calm water.

There are coralline algæ which grow attached to the shells of members of the clam or mussel family. The intimate attachment is probably unwelcome to the clam, although the overshadowing presence of the shrubby stonelike alga may render the clam a service by covering and protecting it from some of its enemies. The algæ in general are not very particular as to their points of attachment, although something substantial and firm in the way of a substratum seems usually to be preferred.

Living corals are found only in the warmer seas; coral-like plants occur not only in the tropics, but also in temperate and frigid waters. Explorers in the Arctic regions have reported great beds of them on the floor of the ocean, mostly in water that is from 60 to 120 feet deep.

A few years ago the Royal Society of London sent a party of naturalists to the South Pacific to study the mode of origin of the so-called coral islands. The island of Funafuti of the Ellice Islands group was chosen for special study because it was believed to be "a true coral island." By means of a drill, borings were made to a depth of a little more than 1100 feet, the cores brought up were carefully studied, and the various groups of animals and plants that had contributed to the upbuilding of this island were ranked in order of their relative importance. The first rank was given to red algæ of the coralline family; the second to lime-secreting green algæ of the genus *Halimeda;* third rank was awarded to the group of microscopic animals known as Foraminifera; and fourth rank to the corals. So Funafuti seems to be "a true coral island" which, strictly speaking, is not a coral island at all!

American geologists are finding evidence that certain limestones, now high and dry, in various parts of the United States and the West Indies, are made up chiefly of the remains of lime-fixing plants that flourished when those parts of the earth's crust were under the surface of the sea. So these hard limy sea plants, living and dying century after century and rising "on stepping-stones of their dead selves," are not only making land today, but their ancestors and relatives did the same thing thousands of years ago.[1] And no small part of the pleasure and satisfaction of exploring the sea gardens of the tropics comes from observing bits of evidence as to how this great work is still being accomplished.

[1] For a further discussion of this subject, see a paper by the writer on "The Building of Coral Reefs." *Science*, XXXV, No. 909, May 31, 1912, pp. 837–42.

The Sacred Bundles of the Pawnee

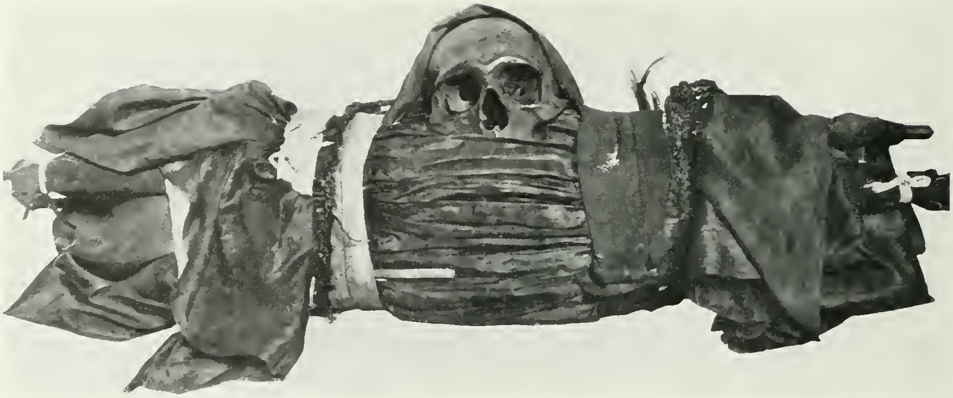
By CLARK WISSLER

THE exhibit of the Plains Indians in the American Museum has been enriched by the display of sacred bundles from the Pawnee. These are in themselves uninspiring objects, but when we once come into some understanding as to their meaning and the place they occupied in the beliefs and philosophy of the original Pawnee, their true significance begins to dawn upon us. Here you may stand and look at leisure upon objects associated with the most sacred and noble thoughts the great Pawnee tribe was able to produce. Such objects are a rarity in museum collections, for they are the greatest of tribal treasures.

We speak of them as medicine bundles, but it is well to note that "medicine" and "medicine bundle" are terms frequently heard when speaking of our Indian tribes. Unfortunately, the word "medicine" carries with it an erroneous interpretation, for the Indian's medicine is not medicine at all. In most cases the Indians draw as sharp a distinction between doctors and priests as we do, and it is rare that both the doctor and the priest take part in the same ceremony, for they more often than not hold each other in contempt. Thus, among the Pawnee, the priests pray to the gods in the heavens, but the doctors pray to the powers in the animals and the waters. The priest is therefore the exponent of the most sacred and highest culture of the Pawnee. This has its analogies in the social life of many other tribes, so we may accept the generalization that most of the Indians within the bounds of these United States clearly distinguish between the functions of a doctor and a priest.

Such a distinction seems self-evident to us; yet, when our forefathers first came in contact with Indian life, they failed to see any distinction between the native doctor and the priest and were so impressed with the functions of the latter, whom they called a medicine man, that they applied the term to all priests and conductors of ceremonies, and likewise used the term "medicine" as a generic term for all objects used in social functions and religious ceremonies, as well as those used in treating the sick. So we have the term "medicine bundle" so firmly fixed in our literature that it must be retained, but these rare bundles from the Pawnee have no relation to drugs or charms for healing the sick. They are in fact symbolic of a series of rituals in which is crystallized the Pawnee philosophy of the universe. The bundles, therefore, are valued solely because of their association with these rituals, for the rituals, or rather the ideas they formalize, are the realities in the mind of a Pawnee.

Again, each of these tribal bundles is associated with a social function, or office. There is, in fact, a yearly cycle of rituals governing the tribal activities of the Pawnee, for each important unit of which there is a bundle, and the priest, or keeper, of this bundle is for the time the leader or director of the people. Thus, the opening of the year is the spring when thunder showers occur. In fact, when the first thunder is heard in the spring, the priest of the leading bundle begins the demonstration of the most fundamental rituals, the creation of the world and life. The bundle used in this ceremony, wrapped in the tawny skin of a buffalo calf so tied as to represent that animal, is known as the "Yellow Calf." Yet the ritual indicates that this bundle gets its sanction from Venus, or the Evening Star Goddess, who in Pawnee belief is the grandmother of man, as well as the

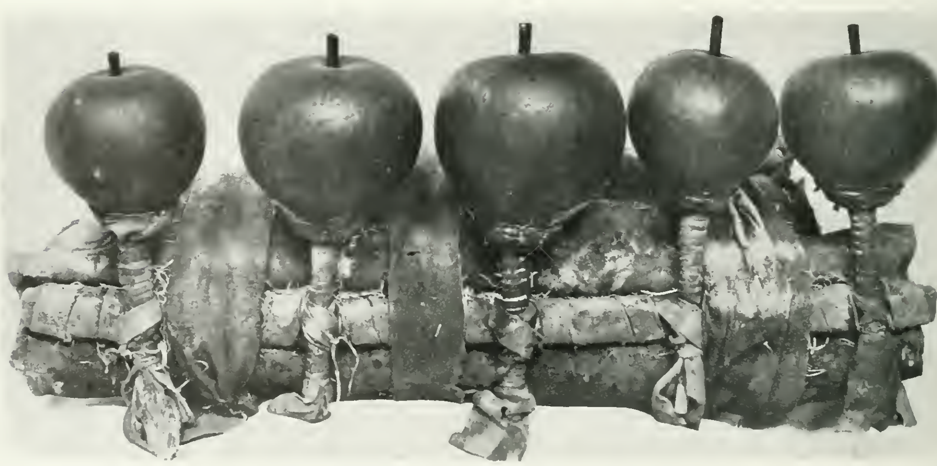


The Pawnee believe that the bundle of the skull descended from the first man. Its priest gives the order for preparing the fields and planting the corn. The women of the tribe do most of the work in the fields and gardens

giver of life to most living beings. This bundle of the Evening Star is, therefore, the highest of Pawnee bundles and, in consequence, the most interesting in the whole collection. It is doubtful if there is any single object in this or any other museum that makes so strong a claim to distinction. That it is here and that the full account of its ritual is on file in this Museum is due to the interest of Mr. James R. Murie, the present hereditary chief of the Skidi Pawnee.

Many peoples, ancient and modern, have looked upon fire as one of the fundamental gifts of the gods. Hence, it is not strange that one important feature of the Evening Star bundle is a set of fire sticks with which the grand high priest of the Pawnee kindled the "new fire" for the new year. The idea underlying all the ceremonies with this bundle is the renewal of life manifest every spring. This is taken as a demonstration by the gods of the story of creation: hence, it is proper that the people have a formal recital of the initial events in the creation of the world, and that fire and everything else of importance produced by human agency be symbolically renewed.

Yet, the most significant object in



A very striking bundle is that of the Kitkahaki Pawnee. Fastened to the outer cover are five large gourd rattles, a pipe, a wooden swordlike object, and some arrows this bundle is the sacred ear of corn. The greatest blessings the Evening Star Goddess conferred upon mankind were buffalo and corn. The teaching is that she placed upon the earth a bundle consisting of the germs of corn closely wrapped in a buffalo calf skin, and as the corn plants burst forth, the skin wrappings arose as a living buffalo. Hence, this bundle is spoken of as the "Yellow Calf," and the sacred ear of corn kept inside as "Our Corn Mother."

We have not the space here to recount the beautiful procedure in which the grand high priest ceremonially plants the seed of the sacred ear and how, at the harvest, he goes in procession to the fields to select the sacred offspring which he conducts ceremonially to its new home in the Evening Star bundle.

Of other objects in the bundle we may mention the sacred pipe with its cloud symbols representing the gods in the west, an arrow-straightener made of antler, and scalps from the heads of enemies. Each of these has its own symbolic setting in the ritual.

Another bundle of almost equal interest is the skull bundle, upon the top of which is a human skull. The belief is that the ritual for this bundle came down from the first man and that when he died his skull was placed upon the bundle. This is not the original skull, however, for there is a tradition that a woman once dropped a tipi pole upon the original, smashing it into fragments, and that the skull of a famous chief was substituted. This must have been many years ago, as the skull is blackened with age.

On the outside of the bundle are a sacred bow with three arrows and two pipestems. Inside are many objects, the sacred ears of corn, the sacred pipe, fragments of the holy otter collar worn by a war leader, the arrow-straightener, paints, and tobacco.

The ritual for this bundle presides over the planting of corn, and its priest gives the order when and how the fields are to be prepared and the grain planted. Since the women are the chief gardeners, they take the leading rôles in the more spectacular parts of these ceremonies.

In addition to these two very remarkable Skidi bundles we have tribal bundles for the Kitkahaki and Chaui divisions. Of these, the Kitkahaki is the more striking. Fastened permanently to its outer cover are five large gourd rattles. Within this wrapping is the bundle made up in a woven bag, containing sacred ears of corn, a sacred pipe, an arrow-straightener, paints, and other objects. Attached to the outer cover are a pipe, a wooden swordlike object, and some sacred arrows.

The Chaui bundle is wrapped in buffalo skin, on the outside of which appear a raccoon skin, sacred arrows, a stick for stirring soup, a wooden paddle, and a swordlike object. Within the bundle are a shoulder-blade hoe, the usual sacred corn, an arrow-straightener, and fresh-water mussel shells for mixing paints.

Besides these four great tribal bundles there are in the collection a number of smaller war bundles. These usually are spoken of as "meteor bundles" because it is believed they contain meteorites, objects looked upon as children of Tirawahat, the supreme god.

This collection is the best series of religious objects on exhibition in the American Museum; yet its value rests not in the possession of the mere objects, for they are commonplace, but, in the manuscript accounts covering each detail of the rituals for these bundles, we have the knowledge as to what these objects symbolized in the thoughts of the Pawnee. Other tribes had bundles, and examples of them frequently find their way to museums, but seldom is there satisfactory knowledge as to their significance. Thanks to Chief James R. Murie, we can look upon at least one set of tribal bundles and see them in something of their true light.

Slabsides, John Burroughs' rustic cabin near West Park, New York

The Optimistic Philosophy of a Naturalist

By G. CLYDE FISHER

Associate Curator of the Department of Public Education, American Museum

JOHN BURROUGHS is not and never has been a preacher. His is not the theological type of mind, but the interpretive type, and in his latest book, *Accepting the Universe*,[1] he does not turn from his literary habit of more than half a century. While this volume is a collection of religious essays, we know our veteran naturalist writes "not to preach, or to convert, or to dogmatize," but to interpret.

There are thousands of lovers of John Burroughs who will be grateful for this book,—who will be keenly interested in what this exponent of the simple life has to say,

[1] *Accepting the Universe*, by John Burroughs. Boston: The Houghton Mifflin Company. 1920.

at eighty-three, about "The Faith of a Naturalist." It is a robust faith. The strictly orthodox reader may dissent from many statements, but all must admit that John Burroughs is a tireless searcher after truth and that he stands reverent and humble in the face of the eternal verities.

The breadth of treatment is suggested by the following quotation: "Were not Darwin, Huxley, Tyndall and Lyell, and all other seekers and verifiers of natural truth among the most truly religious of men? Any of these men would have gone to hell for the truth—not the truth of creeds and rituals, but the truth as it exists in the councils of the Eternal, and as it is written in the laws of matter and of life.

"For my part I had a thousand times rather have Huxley's religion than that of the bishops who sought to discredit him; or Bruno's than that of the church that burnt him."

This production, coming from a naturalist philosopher who really belongs to a former generation, is naturally compared with his earlier books, and in the comparison we are not disappointed, for, judged by the most critical standards, we find it as fresh and as clear as *Wake-Robin* and *Winter Sunshine*. It is written in that charming, unobtrusive style which characterizes all of Mr. Burroughs' essays from those penned while Abraham Lincoln was President of these United States, down to those of the present time.

The only essays of this author, however, which can be closely compared with the collection, *Accepting the Universe*, are those in the volume so appropriately entitled *The Light of Day*, published a score of years ago, a part of those in *The Breath of Life*, and an occasional one in a few of his other volumes. The essays in his latest book are possibly a little more ripe. They are certainly marked by an abiding confidence that whatever is, is right, that this is the best possible world; in short, they are permeated—and this is significant—with a thoroughgoing optimism.

The Proofs of the Evolution of Man

Scientific evidence would indicate that the human race came from small tree-dwelling ancestors in Central Asia

By W. D. MATTHEW

Curator of Vertebrate Palæontology, American Museum of Natural History

THE chief interest of evolution to everyone, the only interest to the "average man," is its bearing on our own ancestry. Mention Darwin to a casual acquaintance, and he immediately thinks of monkeys, and whether or not he is descended from one. Generally he prefers not to be and therefore concludes that he isn't. Even the better informed members of the community, who have read enough and thought enough on this subject to know that this is not quite a correct or complete statement of the Darwinian theory, still consider it as chiefly concerned with the ancestry of our own race. And so perhaps it is from a humanistic point of view. Our own history is after all a deal more interesting to us than other people's. And it is quite proper that scientists, as well as the rest of the world, should give more consideration and discussion to the problems of man's evolution than to any other phase of the subject. Certainly they do so. Every new bit of evidence regarding the ancestry, near or remote, of our species, every new interpretation of facts already at hand, attracts an interest denied to evidence or theories which concern the evolution of the lower animals. A discovery of fossil man, or of prehuman "hominids" as man's immediate extinct relatives have been called, is chronicled and discussed far and wide, not only in scientific journals, but also, and at almost equal length, in the newspapers and popular magazines. Its genuineness is subjected to the most severe scrutiny. Its significance is set forth with a varying degree of pardonable exaggeration by enthusiastic writers, scientific and popular. Criticisms no less vigorous appear in abundance, some based upon a well-informed and conservative judgment of the facts, most of them, one regrets to say, reflecting merely a reluctance to accept evidence that conflicts with accepted theories, and a disposition to minimize its importance and validity.

The interest that attaches to this phase of evolution has been recently illustrated at the Birmingham meeting of the British Association for the Advancement of Science. The Piltdown skull, the latest find of fossil man, was one of the chief centers of discussion, dividing popular attention with Sir Oliver Lodge's speculations on the future life, and the trade problems of the Panama Canal. Other announcements and discussions, some of them of no small scientific importance, attracted little or no notice outside of small groups of specialists. Some of these contributions had an important bearing upon problems of more popular interest. But the relationship was indirect and passed unobserved, its influence to be seen and recognized only at a later date.

In view of their absorbing interest it is peculiarly unfortunate that fossil remains of man and of his prehuman ancestors are so extremely scarce. Nature, in preserving her records of the evolution of life, has shown no preference for her present favorite. While the records of man's ancestry are not quite the rarest of fossils, yet they are exceedingly rare in comparison with the fossil remains which illustrate the evolution of many well-known races among the lower animals. The record is imperfect, and it quite fails to furnish that overwhelming mass of direct evidence which would refute and silence all opposing criticism. The evidence for the evolution of man, for his descent from a common ancestry with the lower animals, convincing as it is to every well-informed and unprejudiced scientist, is yet chiefly indirect evidence, and the lack of direct evidence has always been a stumbling block to the evolutionist in his attempts to convince the world at large of the truth of his theories. It is quite true that with many—indeed with the greater number—of the races of lower animals now in existence, the direct record of their past history and evolution is as imperfect and inconclusive as that of man, or more so, and yet this does not deter the opponents of evolution from accepting the theory in regard to all other animals while denying it with respect to man. But in these cases the evidence is considered impartially. If the critic accepts the theory of evolution of the horse and the dog, as proved by both direct and indirect evidence, he has no especial difficulty in accepting it for the angleworm upon the indirect evidence of structure and physiology alone. But he draws the line at man, and declares that while the mind and body of a dog may have been evolved from a bit of protozoan jelly by the slow and gradual processes of natural evolution, the mind and body of a man cannot have been so evolved.

With the logic of such a position or the often ingenious arguments by which it is defended, I am not here concerned. Plainly stated, this is the view taken, not indeed by scientists, but by a large section of the nonscientific world. The lower animals may have been evolved through the processes of natural law, but man is a special creation, his fundamental and detailed resemblances to other animals being obscured in their minds by the disproportionate development of his mentality, looming large in the close perspective in which it is viewed, and the differences further accentuated by a new set of terms applied to various phases of this exaggerated and highly specialized mentality, phases of which the germs may be obscurely seen in the higher quadrupeds, but which appear definite and distinct in man.

Obviously the only evidence that will convince the opponents of evolution will be the discovery of a complete chain of ancestral stages connecting man with the primitive tree-dwelling ancestors from which the indirect evidence indicates his descent and of which the living apes, monkeys, and lemurs are more or less altered survivors, in varying degree less progressive. But only a few fragments, broken links of such a chain, have as yet been found, and their pertinence to man's ancestry rather than to some other related chain of descent is in every instance open to more or less question. There is nothing exceptional about this, unfortunate as it is. There are many races of animals of whose evolution there is little or no record among fossils. Several reasons account for this imperfect record.

(1) There may be no hard parts in the body, so that nothing can be petrified and preserved, save under most unusual circumstances.

(2) The hard parts may be small and delicate, and the habits and dwelling place of the animal such that its remains would rarely escape destruction before they could be buried and preserved by petrifaction.

(3) The animal may have lived only in some of the unexplored or inaccessible regions of the world, or in areas where no geological formations were being laid down at the time, or where such formations have not been preserved to the present day.

While the first reason does not apply to man's ancestors, the others pretty certainly do; and so far as one may judge, they account quite satisfactorily for the scarcity of the remains.

There are several lines of evidence—historical, archæologic, ethnographic, etc.—that concur in indicating the continent of Asia as the probable cradle of the human race and more probably north than south of the Himalayas. Here we believe that man evolved from small tree-dwelling monkey-like ancestors, and from this central region he spread to east and west and south, finally overrunning all the outlying continents and the islands of the ocean. Here, then, somewhere in the great desert regions of Central Asia, we may hope to find the earliest human remains and the fossil bones of man's ancestors, in the Tertiary formations which may be discovered and explored by the scientists of coming generations. As yet the geological exploration of the world is but in its beginnings. The preliminary reconnoissance and mapping of its strata are well advanced in Europe and North America, elsewhere they have only commenced. And the more thorough search by which the fossils characteristic of each formation are secured for study and adequate evidence obtained of the successive faunas and floras which inhabited the region, has covered only a part of Western Europe, a minor part of the United States, and a few scattered areas elsewhere.

THEY ARE THREATENED BY STARVATION EACH WINTER

With the first snows of autumn the elk start slowly on their annual migration to the lower, sheltered valleys where the grass is not too deeply buried and the winter winds are broken. Only great bulls in their prime, able to paw through deep snow, remain scattered within the middle valleys of the park, or even on the mountain tops where the wind clears pasturage for them. The chief danger which threatens the herds is progressive occupation of their winter ranges by cattlemen and hunters. In former years the elk passed downward to the plains, but now these are all occupied, and the elk by being restricted are threatened with starvation. If they wander beyond the protection [illegible] thousands to their destruction in Montana

Story of the Whitebar Elk[1]

By M. P. SKINNER

Park Naturalist, Yellowstone National Park

IN the northern part of Yellowstone Park there is a quiet and lovely valley; through it flows Slough Creek. The valley bottom is a long meadow divided midway by a short and rocky cañon; it is from one to three miles wide and bordered on either side by high and rocky ranges that still show the effects of the resistless forces of the Glacial epoch. These ranges are covered on their higher slopes by a dense growth of pine, while the lower are unusually beautiful with their numerous open, grassy parks, alternating with groves of quaking asp, of fir, and of pine. The upper meadow is, for the most part, covered by grass, with low willow thickets along the stream; the lower meadow is still more striking with its smooth, green level, broken by clumps of quaking asp, with here and there a few dark firs. This valley is a favorite winter feeding ground for immense herds of elk with an occasional mule deer, or a buffalo. In the spring its meadows and ponds are frequented by vast numbers of Canada geese, and by many species of ducks and other water birds; and in the late summer and early fall Slough Creek is a famous fishing ground for the black-spotted trout.

To us, it is especially interesting as the winter and spring home of the elk. It was here in early June when the bright green grass and the fresh, rather yellowish, foliage of the quaking asp formed a delightful contrast with the darker fir groves, that "Whitebar" was born. I may call him that now but our little elk was not known then by the name, for it was much later in his life that the sportsman's bullet seared its way across his shoulder. He was only one of many elk born that year in Slough Creek Valley, but none among the many was destined to become as mighty a bull as he and as great a king among his kind. He was dark brown in color with numerous spots of lighter brown; his legs were too long for him, and only just strong enough to support him for a few minutes at a time.

His mother hid him carefully in the weeds and brush whenever she left him to find grazing for herself, and by some strange instinct he always remained so hidden until she returned. It was while he was thus concealed that he had his first adventure, for one day one of the soldiers that formerly guarded the park came down the banks of Slough Creek and found him. The care of vast numbers of animals has its effect upon the men who guard them. They lose much of their desire to hunt and kill. This soldier had no evil intentions toward the big-eyed, helpless little animal lying so motionless; but he did wish to test what he had so often been told—that a man is able to catch a very young elk when it is hiding. He did actually pick up the baby and place it upon its feet. In doing so, however, he broke the spell that had caused the little elk to lie so still, and it ran as fast as its tottering legs would permit—luckily in the direction of the returning mother.

After a week or ten days of this hide-and-seek life, the little elk's legs became more serviceable and his mother led him by slow and easy marches (gradually increasing in length each day) out of Slough Creek bottom and up on the heights of Specimen Ridge to the south. Specimen Ridge is a fine open grazing ground, high enough to escape the heat and the flies of the lower valleys; but for our elk and his mother it held one grave and unforeseen danger. Coyotes are not very formidable enemies of the young elk when their mothers are with them. But when our elk was a month old, a large coyote, fierce and hungry because of a long term of unsuccessful hunting, made a desperate attempt to get Whitebar. It was early in the morning when the fight began. The mother elk could fight only by attempting to strike with her forefeet or to knock the enemy over with her head. The coyote was too swift for her to run down or chase away; and besides she was hampered by the little elk, which kept close to her side or at her

[1] Illustrations from photographs by the Author.

THE ELK OF THE YELLOWSTONE

The herds of the Yellowstone National Park region are the only remaining great stand of elk in the United States. The mountain ranges at the headwaters of the Yellowstone and Snake rivers have long been a summer feeding ground for these great game animals where as many as 25,000 come with the melting of the snow to graze on the fresh grass of the alpine meadows. No inducement other than protection is necessary to keep the elk within the park, for they unerringly find and occupy areas closed to hunting heels. On the other hand, the coyote had to be very wary and very cautious; one successful blow from the elk's lightning-swift hoofs would mean his death.

The struggle went on all that long, hot day: the coyote continually worried his prey but was forced to keep out of range of those terrible hoofs; the elk continually tried to get in one deciding blow. More and more tired became the mother until it seemed as if she would lose her life in defense of Whitebar (for she could have run away at the beginning had she cared to do so). No help seemed near for her; and that menacing gray form was always just before her and always just out of reach. But help was near. Late that afternoon a government ranger came riding by. The coyote saw him in the distance, and well he knew what rangers are; well he knew that they carry death-dealing rifles; and well he knew that there is no sanctuary within the park for such as he. The coyote was forced to run, and our little elk and his mother were saved; but it was many a day before they recovered their strength, and perhaps they never would have recovered it if the rich grass had not been thick and easy to get on Specimen Ridge.

For the rest of that summer our elk remained upon the upland grazing grounds with many other elk and their calves, always busily feeding and gradually taking on fat to help them over the coming winter. On the approach of fall the young elk gradually lost the spotted coat of his babyhood and his hair grew longer, thicker, and was lighter in color. As cold weather drew near, the mother took him down toward the valleys, forded the Yellowstone River, and passed near Tower Falls. Slowly, very slowly, going only a mile or two a day and often retracing their steps, they made their way past the Petrified Trees and Yancey's, and on to the country of the Blacktail Range. By the time the first severe snow came they were safe in a well-protected valley where the snow did not fall as deep as upon the higher altitudes they had left.

Now the winters in Yellowstone Park are likely to be long and a very severe test upon the strength of all the animals. Food is scarce and hard to get, and the long, bitterly cold nights often kill the half-starved and weakened animals. That this first winter of our young elk's life happened to be a mild one was of vast importance to his growth. He was already a well-grown little elk owing to his mother's good care and the nourishing grass they had had all summer. The only setback had been the coyote fight, and he had not taken the brunt of that. During this mild winter the mother elk was able to secure a fair supply of food in places where the wind had blown off the snow. Often she pawed the snow with her forefeet; and often, when the snow was freshly fallen and light, the elk were able to push it aside with their noses while they fed on the grass exposed. As spring drew near, the sun became warmer and warmer, and by the end of February it had melted the snow a little, revealing many patches of grass which had been hidden during the winter. Later, fresh grass appeared here and there, and the starving time was over.

One day Whitebar wandered a short distance from his mother, and when he came back, she was gone. Of course, he did not know that it was usual in elk land for calves to lose their mothers about this time of year. He was a self-reliant young animal, however, and although he looked for his mother for a week or more and occasionally called for her, he never saw her again. Still he managed to get on, for she had done her work well and he had become wise in the ways that young elk should know.

The weather grew warmer and he climbed higher and higher. He did not return to the Specimen Ridge of the previous summer, but instead he made his way in a southwesterly direction. One morning as he was resting under some pines, he was startled by strange noises. By this time, our elk knew all the more common sounds of the forests and meadows, but this was like none of them, being far louder than any he had ever heard. As he hesitated whether to run or to find out what the noises meant, he saw a stage-load of talking, laughing people going by through a little meadow not far off. After that morning, he saw many more tourist stages; their approach was always heralded by the strange noises, and they always went hurriedly by. But they did not hurt him, in fact I doubt if any saw the elk peering out at them from behind some convenient thicket of small pines. They were a source of much curiosity to Whitebar; and as he got used to them, the happy joyous people seemed to fit in with the birds and animals about him and he was not afraid.

After a short time the weather became still warmer and the flies more annoying, and the elk was forced to move on again. In seeking the higher mountains, he entered a strange valley, where the ground was quite white and had neither grass nor trees upon it. From many parts of it columns of steam rose high in air, and often jets of water spurted into the air only to fall back again. There were many strange sounds of roaring, hissing steam and water falling and dashing upon the rocks. The air was filled with hot, acrid, stifling odors; and again there were tourists, but there were no stages and the people were walking to and fro over the white ground among the rising jets of steam and water. In fact, our elk had happened upon the Norris Geyser Basin. He crossed it after the sight-seers were gone and continued on up the hills before him.

In time, he reached the top of the Madison Plateau; and finding among the cool pine forests abundant food and freedom from the little stinging flies, he spent the rest of the summer there. Now all through that summer the first pair of horns had been growing. They had only two points on each antler, but they were the forerunners of many mighty antlers to come, for elk shed their horns every spring and grow another pair during the summer. These first horns were small and the covering of skin or "velvet," as it is called, remained upon them—as it often does on an elk's first set of horns.

At the approach of his second winter our elk turned northwest and descended into the Madison Valley, instead of returning to the northern section of the park. This was another fortunate move that no doubt had its effect upon his strength and growth, because the second winter of an elk's life is the critical period that determines whether he will be large and strong, or remain commonplace. The grasses of the Madison were particularly luxuriant, and there were fewer elk there so each had a larger share. This winter was an average one but he was able to get abundant food all through it, and when spring came he already showed many signs of the great strength and beauty that were soon to be his.

Whitebar spent his third summer, and had his last experience as a member of a herd, in the upper Hayden Valley with the cow elk, small bulls, and calves that usually summer there. This year he grew a pair of horns that had four points on each antler; and unlike his first pair they lost their velvet in the fall and were sharp and serviceable.

But that third winter is one long to be remembered in those mountains. The snows came early and fell fast and heavy. From October to June the storms were almost incessant; snow followed upon snow with but little interval. Among the animals it was the great starvation year. As the snows grew deeper and deeper, the elk found it more and more difficult to get enough grass to sustain life. Then spring approached, and still there was no decrease in the fierce snow squalls that swept the region, no break in those bleak, wintry days, and the elk began to die by scores. By the time the warm June sun appeared, the terrain was covered with hundreds of dead and dying animals. How was it with Whitebar? Again we see one of those lucky happenings which contributed to make our elk the magnificent animal he was. Early in the winter he had found a partly spoiled stack of hay left by the men who had gathered hay for the Buffalo Farm. When forage became scarce he returned to it and never during those bitter days did he wander far from it. It was his salvation, for he came through that trying time very much better than did the other elk.

He passed his fourth summer in great contentment and grew his third pair of horns, a full-sized pair with five points each. Elk horns may grow much larger, with six, seven, and even eight points, and a few curiously deformed horns have many more. Nevertheless five points per antler is the full-grown size. Our hero, then, had now come into his full elkhood. He felt it in his strength and power, and showed it when he began instinctively in late August to "horn the brush" in his endeavor to rid his horns of the still clinging velvet. Early in September he gave another sign of his maturity in attempting to whistle, or "bugle." Other deer, notably the moose, give similar challenges; but neither do the notes become so clear and ringing in any other mammal, nor does any other issue these challenges so frequently. Nor have I ever heard any other deer challenge just for the fun of it, as elk seem frequently to do. Each autumn the elk whistles are to be heard all day long on a good range and often all through the night, although the early morning is apparently the favorite time. With elk the bugle seems to be an incident of the mating season. It is at times a call, a challenge, or occasionally just an expression of the life and power that the elk feel coursing through their veins. The rutting season lasts from early September to late October. To one unaccustomed to elk on their native range it is a great experience to be among them while the bulls are bugling and often fighting, and the mountains that have been so silent and forbidding all summer suddenly seem full of life.

Early during his next winter, our friend gave another sign that he was now a full-grown elk. Instead of descending to the low valleys, he elected to spend the winter upon the Blacktail Range of mountains. Bull elk in the prime of life often spend their winters high upon the open ridges from which the winter winds sweep away the snow. The brave, hardy animals are even better sustained than the elk of the low levels, for the grass is nourishing and easily obtained; but woe to the weakling that braves the winters in such exposed places. Our elk did well on the wind-swept ridges of the Blacktail Range.

In April Whitebar shed his horns again, and only the bony butts were left. As soon as the horns dropped, the skin grew up over the tops of these butts, which in turn began to swell. Thus within a week after the falling of the old horns, a pair of skin-covered knobs took their places. They were about the size of a large tomato, rather darker in color, and full of hot, swiftly flowing blood. They kept right on swelling, but it was noticeable that soon they began to acquire shape. Rapidly they grew, forming branches and points at their proper places, each branch and point ending in a knob until it was completed. During this growth the horns remained covered by the skin (or they were "in the velvet") and filled with numerous blood vessels carrying the rich material necessary for the rapid growth. The horns were extremely sensitive to the touch while in the velvet and the elk carefully avoided hitting them against anything. By the end of July the antlers had stopped growing; the knobs had been gradually absorbed; the velvet had dried and withered; and the horn structure itself had hardened, losing the blood vessels which had furnished the growth and the nerves which had prevented injury to the horns by making them sensitive.

While his horns were growing he had other experiences. He had worked along the mountain range to its southern end and crossed over to Mt. Washburn. Here he encountered men again, but these were far different from the tourists he had watched so long before. They were more silent and did not travel in stages. They were engineers engaged in the work of building a road to the top of Mt. Washburn. They did not bother the elk and soon he became used to them. So little did he fear them that later when they blasted out the rock, he remained feeding indifferently within a few hundred feet. Had he only known it, he was witnessing a wonderful sight; at noon when the men went to lunch, long lines of blasts were set off. The whole crest of the mountain would seem to rock and shake with those tremendous salvos resembling the discharge of powerful guns along a lofty rampart.

This familiarity with men was like to have cost our elk dear. That year in following elk custom during the rut he wandered far and near and soon he was outside the east boundary of the park. It happened that a sportsman was there too; but the elk was not frightened until the report of a gun sounded and our elk felt a hot, stinging blow along his side. He ran, and fortunately ran into the park so that the hunter could not follow. By instinct he began to climb the mountains and soon he lay down on a snow bank and his fevered side was cooled; that night it rained, and the water washed out the wound and helped to cool the mounting fever. Luckily that autumn was an open one and the heavy snows were late in arriving. Our elk remained near the mountain tops, feeding when he could and often lying down on the snow banks. Slowly he recovered and was able to get down to the winter range near Soda Butte. It was well along in the winter before he fully recovered and he was left with a white bar across his left shoulder that won for him his name.

That winter Whitebar moved to and fro throughout the northern part of the park. In March he found himself in what is known as the Hellroaring country, from a creek of that name. This was a fine winter grazing ground but infested with mountain lions. A mountain lion usually hunts by lying in wait in some tree or on some high rock above the trail, pouncing down upon the prey as it passes underneath. Mountain lions do not as a rule attack full-grown elk, and, moreover, Whitebar was especially wary and fleet. Thus he passed safely through the winter in the big cat's country.

The sixth summer was spent amid the many beautiful open parks on Mirror Plateau. Often he met others of his kind, but the summer was a time of peace in elk land and these meetings were uneventful. Often, too, he met coyotes and even bears, but none cared to attack an elk of Whitebar's size, especially as other food was plentiful and easier to get.

It so happened that this season was a dry one and the grass for winter forage did not grow well. Whitebar wandered back again to the Slough Creek, and for a time did well on the scattered feed; but long before spring the forage gave out. Our elk, however, was now big and strong and with the help of bark from the quaking asp he was able to get through. But the year was a hard one on the other elk and before fresh grass appeared all the aspen trees were barked from the ground up for five feet, and even higher where the snowdrifts afforded a platform on which to stand. Often the elk were able to push over the weaker trees and then not only was the bark completely stripped off, but all the twigs and smaller branches were eaten also.

Whitebar was now a great bull elk, mighty in size and strength. Many experiences and escapes had made him wise, and he was quick to scent danger and quicker still to get away. Among his own kind he was a king, ruling absolutely the little herd of cows that he acquired each year. Rivals he fought at sight and usually conquered. If the defeated elk had had a following of cows, Whitebar took them as his spoils of battle. Thus by the time autumn was over he was the center of quite a herd—only to lose them during the winter when the fight for existence drove every elk, cow and bull alike, to look out for itself.

Well do I remember a fight I witnessed between Whitebar and another bull of about the same size. It took place in an open vale almost surrounded by dark pines and firs at the edge of the flats of the upper Yellowstone River. On the east was a towering range of mountains over which the sun was just appearing. The morning was still and frosty, and a foot or so of light, fluffy snow covered the ground, although it was only October. I had been conscious for some time as I came down the trail that a bull elk was bugling ahead of me. Just as I neared the edge of the timber, an answering challenge came. I hurried carefully forward, for a meeting between two big bulls such as the hoarse notes revealed them to be would be an event. Soon I caught sight of Whitebar. There was no mistaking him. The peculiar mark across his shoulder was gleaming white in the sunlight. Very many times before had I seen this elk, and many hours had I spent in admiring his strength, his beautiful form, and his majestic appearance. During the years I had known him Whitebar had grown larger and larger until he was known far and near as "the big bull." Each year his horns had grown larger and had excited much admiration among the men who knew him. Many were the schemes of hunters to get him, but Whitebar was too wary. I doubt if he had any idea where the park boundaries were, or even if there were such things, but he did know where he was safe. He did not know that as long as he remained within the park the long arm of the government protected him from the one enemy with whom he could not cope, but he did know that in certain places men never bothered him. He no longer feared any enemy; in fact he had no enemy, except man, as none cared to pit himself against the prowess of the monarch of the Yellowstone. He was monarch of the mountain parks and meadows just as truly as his big relative, the moose, was monarch of the marshes, and as the grizzly was monarch of the forests.

When I came in sight of him that morning, Whitebar was horning a pair of four-inch saplings; and he did it with a vigor that tossed the saplings this way and that and all but uprooted them. Later I tried to shake those saplings myself and could just barely move them by a fraction of an inch! Occasionally he stopped to bugle and always came the answering call, nearer and nearer. Soon the on-coming bull walked into sight, and he was almost an exact duplicate of Whitebar in size. At the same time Whitebar left his saplings and came to meet his adversary. Slowly they approached each other, slowly lowered their heads, and gently placed their horns together. But at the touch, the power lurking in strong muscles awoke; harder and harder came the strain. The fight lasted only a few minutes. Each combatant strove to push the other back, occasionally the horns would separate only to come together again with a sharp crack. Only in the "cracks," in the straining muscles, in the fierce bloodshot eyes, and the panting snorts could one see the tremendous power being expended. At times one of the elk would give a savage side twist of his horns to reach an unguarded flank. But always the opponent was able and spry enough to spring around and escape. And then the straining pushes and panting snorts would begin again as the two powerful heads came together once more.

Slowly the stranger elk was pushed back step by step only to recover and force Whitebar in his turn to give way. There was little to choose between the two combatants; they seemed equally powerful and equally determined to win. Round and round they went, first one would gain a little and then the other, but neither could master. Suddenly the stranger went down on his knees. Was he overcome by strength, or had a piece of ice proved a treacherous foothold? Or had the snow concealed a soft spot of ground? Be that as it may, the fight was over. The conquered elk slowly retired with many an angry shake of his antlers, and Whitebar was left the victor of this, his greatest battle.

For protection of the Yellowstone elk during the winter the Biological Survey and the Forest Service propose an extension of Yellowstone Park southward, the setting aside of state game refuges, and the establishment of government ranches where hay may be raised for emergency feeding in severe seasons. Hunting licenses in surrounding states must also be limited and legitimate hunting regulated so that only the annual increase is taken. The present herds will not be enlarged, except at certain points, for the available ranges will not support greater numbers of grazing animals

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T. GILBERT PEARSON

President, National Association of Audubon Societies, Elected October 26, 1920

Mr. Pearson has been affiliated with the National Association of Audubon Societies since January, 1905, when he was engaged to assist Mr. Dutcher and was elected secretary of the newly incorporated association. From the time in 1910 that Mr. Dutcher became incapacitated for work until now the administrative affairs of the association have been carried on by Mr. Pearson. As a tribute of respect, Mr. Dutcher was retained as president until his death, July 1, 1920, and at the meeting in October Mr. Pearson was elected his successor

A Year's Progress in Bird Protection[1]

By T. GILBERT PEARSON

President of the National Association of Audubon Societies

ONE of the most significant occurrences in the field of bird protection the past year was the decision of the United States Supreme Court upholding the constitutionality of the Migratory Bird Treaty Act. This was the final scene in the drama which began in 1904 when Representative George Shiras, 3d, introduced in Congress the first bill intended to place under federal protection the fortunes of North America's migratory birds. All Audubon Society members will be interested in the final outcome of this long-waged battle in which the National Association and its affiliated organizations have taken such a prominent part. It was at our suggestion and through our insistence that the original bill was modified to include the protection of migratory nongame birds.

The past year has seen further efforts to open conventions with the republics to the south of us with a view to securing protection for our birds that migrate to South America. The urgency for such a course does not yet lie clearly before us, but the matter is under advisement and the United States Government has sent a naturalist to South America to investigate the benefits to be derived.

Of late, vicious attacks on the national parks have been made in Congress by those who would grant favors to western land interests at the expense of the country's richest nature sanctuaries. A bill to allow certain exploitations of the Yellowstone National Park came very near of passage, and another, intended to place the authority for granting water power rights in the national parks in the hands of three members of the President's Cabinet, actually passed both Houses of Congress, and President Wilson, in spite of an avalanche of letters and telegrams, signed this measure and it became a law. This statute should most certainly be repealed at the coming session of Congress. Much effort undoubtedly will be required to defeat other Congressional measures for exploitation of national parks. Attempts to secure such adverse legislation now seem most certain.

In January, 1919, through the columns of *Bird-Lore* this association first advised the public of the Eagle Bounty Law in operation in Alaska. Since then we have continued to bulletin, from time to time, the results of this measure. The last report from our representative in Alaska showed that the official territorial records reveal the fact that bounties had already been paid on the feet of 8356 eagles. Nor does this tell the entire story of the appalling slaughter of the American eagle, for it should be borne in mind that to collect the fifty cents bounty it is necessary to bring in the feet to some territorial official and pay a fee for an affidavit to accompany them before the bounty can be collected. Men who secure only one or two eagles at a time, or who shoot their birds a very long distance from the place where the bounty is paid, of course never report their killings. Furthermore, many hundreds of eagles undoubtedly are wounded by gunfire and escape in the wilderness to die later from their injuries. We have filed the most vigorous protests against this law and for a time it appeared there were prospects of getting it repealed by the territorial legislature, but the latest reports are that a great majority of the people of the region, including Governor Riggs, have such fixed ideas of the destructiveness of this bird to fish and game that the Bounty Law is in no immediate danger.

By the death of the president of the association, William Dutcher, on July 1, 1920, there passed away the leading pioneer in the cause of American bird protection. He was responsible for the establishment of this association, and from the time of its incorporation in January, 1905, until he was stricken with paralysis in October, 1910, its growth and welfare were matters of ever-abiding concern in his mind. Although helpless for ten years, and deprived utterly of the power of speech or the ability to write,

[1] Extract from the report presented at the annual meeting of the National Association of Audubon Societies, held in the American Museum of Natural History, October 26, 1920.

he never lost interest in reading or hearing of what was being accomplished for the cause that lay so near his heart. The memory of his name and his work will never fade as long as men take note of the feathered guardians of the field, or lift their heads to listen to the wild, sweet music in the trees.

This association's system of employing special guards to protect important breeding places of water birds cannot for one moment be relaxed. This is one expense that has to be met every summer, no matter how limited the funds may be or how strong the calls come for expenditures in other directions. Sad experience has shown that, especially in the case of the nesting egrets, a colony left unguarded means a colony in which the birds are sure to be shot.

During the past year we employed thirty-seven wardens, distributed as follows: New York, 1; Massachusetts, 1; Virginia, 1; Georgia, 1; North Carolina, 1; Mississippi, 1; South Carolina, 2; Michigan, 2; Louisiana, 3; Florida, 11; and Maine, 13. The nesting season in the guarded colonies was a fairly good one for 1920. The loss of life from high tides and storms was not greater than for an average normal year, and no raids of consequence were carried out by feather hunters.

During the spring the United States Biological Survey detailed special agents to operate in Florida in order to break up, as far as possible, the illegal traffic in aigrettes. The secretary of the association had supplied the chief of the Biological Survey with a long list of names of people who, it had been reported, were engaged either in killing birds or shipping plumes in that state; and to assist in carrying on this work the association appropriated $1600 for the Survey's use. A large amount of patrolling was done by these wardens in southern Florida with much attending publicity. Also some violators of the law were apprehended and fined, notably a man named Mackinson, of Kissimmee.

We have no Audubon wardens located in New York City, although we could use one or more to most excellent advantage. Members of the Association and others often report by letter or telephone violations of the bird and game laws. These reports we at once place in the hands of the state game warden department for the state from which the complaints were received, and many prosecutions have resulted.

The "field agents" employed in recent years have been continued: E. H. Forbush, for New England; William L. Finley, for the Pacific Coast; Winthrop Packard, for Massachusetts; Mary S. Sage, for Long Island, New York; Arthur H. Norton, for Maine; Frances A. Hurd, for Connecticut; and Herbert K. Job, in charge of the Department of Applied Ornithology. Through lectures, published articles, correspondence, and personal work, this body of men and women are annually performing services of great value to the cause of wild-life protection.

All previous records in the organization of Junior Audubon classes were broken the past year. Before the spring had far advanced, the 200,000 sets of literature, bird pictures, and Audubon buttons prepared for the entire year's work became exhausted. Eighty thousand sets of leaflets and pictures left over from previous years were brought out of storage and were readily accepted by pupils and teachers in lieu of this year's material. By the middle of May all possible sources of supplies had been exhausted and regretfully we began returning to the disappointed children their ten-cent fees. Our ever-generous and unknown benefactor again gave $20,000 to this cause for the past year. With a total of $27,500 we enrolled and provided supplies to 280,963 children in the United States and Canada. I regret to state that collections for the coming school year have not thus far been as good as last, and the prospects are now that little more than two-thirds as many children can be supplied this year as last. To those who may see this report and who, seeing, care for children and the birds, let me remind them that for every gift of $100 for this work about 1000 children will be able to join the Audubon Society, wear its button, study its lessons, and learn many worth while facts concerning the wild bird life about them.

The Question of Correct Diet

TEACHING FOOD HYGIENE TO SCHOOL CHILDREN BY MUSEUM METHODS

By MARY GREIG

Assistant, Department of Public Health, American Museum of Natural History

THERE is abundant evidence to show that proper food promotes health. Plants under experimental conditions can be made sickly by the wrong food or healthy by the right food, and the same is true of animals, and of course of children. In all these cases the sickly individuals might just as well have been strong and healthy. There is nothing essentially difficult about the subject of nutrition. We could just as easily learn good habits of eating in youth as the bad ones we learn now, and the American Museum is planning to do all it can to help the children of New York City along this profitable road to learning.

The attention given to the food problem during the last five years has resulted in a real and permanent gain in so far as it has turned our minds from eating for the mere purpose of pleasing the palate to a consideration of the scientific use of foods for the satisfaction of the physiological needs of the body.

The shortage of food in Europe during the war forced statesmen to realize that the food supply is one of the chief problems of national existence. England, a manufacturing nation, imports two thirds of the food she eats. The German submarines reduced by one half the number of ships that could be used to transport this food. Despite this handicap, the use of a scientific rationing system for all staple foods brought about a condition whereby "there was probably an actual increase in the average consumption of food in the United Kingdom in spite of the world shortage of food,"[1] from 1916–18. A nation with such an accomplishment to its credit will hardly be likely to go back to the ignorant and haphazard methods of pre-war times, when, as is shown by the figures of Rowntree, 30 per cent of the population was improperly nourished.

Possible Food Resources of the World Far in Excess of Any Present Demand

The world shortage of foodstuffs is due largely to mismanagement and lack of organization, and not to any inability of the earth to support its inhabitants. There are acres of exceedingly fertile marsh land which can be drained, and deserts which can be irrigated. The food resources of the sea and of the tropics are barely touched; and development of many areas now unproductive is made possible by our victories over the mosquito and other disease-causing insects. Russia could perhaps easily double her population if she utilized her unused grain lands, and even the Chinese and Japanese have by no means caught up with their resources. "With every article of food except meat we can easily and greatly increase the supply in the western world."[2]

Science has only begun to show us a few of its limitless possibilities. By its means we have increased the sugar content of the sugar beet sevenfold through selective breeding. We have discovered how to prepare a synthetic dye, thus releasing for food the acres previously planted to supply indigo. We have scarcely begun to attack the problem of "waste" in the transportation of food. The saving that can be accomplished here is a potential resource of enormous magnitude. "Half of the fruits and vegetables produced in the United States never get to market."[2]

America a Food-exporting Nation Yet Malnutrition One of the Country's Real Problems

In the last fifty years the population of this country has increased from 38 million

[1] *The Oliver Sharpey Lectures on The Feeding of Nations.* By E. H. Starling. Longmans, Green and Co., London and New York, 1919.

[2] *The World's Food Resources.* By J. Russell Smith. Henry Holt and Company, 1919.

to 104 million, and although, because of our great resources, we are still a food-exporting nation, we face a real problem of malnutrition throughout all parts of our country. Conservative government statistics place the number of undernourished children in the United States at about three million. This condition is by no means confined to the children of the poor, but is also prevalent where there is ample money to buy proper food. Such widespread malnutrition is due mainly to ignorance of food values, but it is more serious to be ignorant nowadays than ten years ago because high prices have reduced the variety of foods from which our selection may be made.

How Shall We Inculcate Correct Dietary Habits?

It has always been realized that the quickest and most lasting reforms can be brought about by concentrating our efforts upon the children. This is particularly true in matters of diet because any dietary reform involves changing our habits. We may convince a grown man that he should reduce the quantity of meat in his diet and eat more vegetables but if he is used to meat two or three times a day and the flavor of vegetables seems too bland to his pampered taste, the likelihood of bringing about a permanent change is often slight. It is not until some serious disease threatens his usefulness in middle age that many a man consents to eat for the sake of the welfare of his body as a whole. The unperverted appetite of a properly trained child of four years, which leads him to take with evident relish a piece of bread, a dish of carrots, or a glass of milk, is an object lesson to us. The purpose of dietary education is to transform this rational appetite for simple foods

				Vitamines		
	Energy	*Protein*	*Mineral Salts*	*Fat Soluble*	*Water Soluble*	*Anti-Scurvy*
Grain products and dried beans and peas	Cheapest source	Cheap source but deficient in certain necessary kinds of protein	Good source of certain salts but low in calcium	Variable	Present except in highly milled grains	Lacking
Meats	Costly source but depends largely on cut	Contain proteins of good quality	Source of iron but lacking in calcium	Not abundant	Present	Very low content
Root vegetables	Fairly cheap source	Contain certain proteins but inadequate as sole source	Good source	Variable	Present; better source than meats	Present; usually abundant
Sugars	Very cheap source	Lack proteins	Lack salts	None	None	None
Fruits	Fresh fruits expensive source; dried fruits fairly cheap source	Poor source	Fresh fruits costly source; dried fruits cheap source	Unknown	Present	Abundant especially in orange, lemon, and tomato
Nuts	Cheap source	Fairly cheap proteins but inadequate as sole source	Good source	Unknown	Unknown	Lacking
Milk	Fairly cheap source	Good quality proteins	Best source	Abundant (Milk is the best source of this vitamine)	Present	Present
Leaf vegetables	Very little energy value	Fairly good source	Valuable source especially for calcium and iron	Abundant	Present	Present; usually abundant
Butter	Cheap source	Lacks proteins	Poor source	Abundant	Lacking	Lacking
Eggs	Expensive source	Expensive source but contain proteins of excellent quality	Rich in mineral salts. Lower than milk in calcium	Abundant	Present	Unknown

Special values of various foods.—This table has been prepared to accompany the traveling exhibit sent out by the American Museum, and to show clearly and concisely in chart form the rôle played by each type of food in the diet,—which food constituents it supplies and which it lacks

The problem of malnutrition among school children is being attacked by the New York City Department of Education, in coöperation with the American Museum, by means of a traveling exhibit illustrating the correct principles of diet. The exhibit includes eight wall charts, a set of colored blocks setting forth the composition of six common foods, and, of primary importance and interest, a set of sixteen wax models of foods for sample menus for a day's meals. This picture shows the models of the various dishes for a sample breakfast suitable for a child from ten to thirteen years of age. There are 1 cup of oatmeal, 2 slices of toast, 1 tablespoonful of butter or butterine, ⅗ of a cup of cocoa, 1 baked apple with sugar, and ⅔ of a cup of milk. This sample breakfast represents a heat value of 600 calories; it contains 15.76 grams of protein and the necessary amounts of iron, phosphorus, and calcium. Each of the models individually represents a heat equivalent of 100 calories so that the children can readily grasp the idea that a certain portion of food stands for a definite energy content

into a habit of correct eating which will last into adult life.

American Museum Campaign Among the School Children

A special campaign to combat malnutrition is now being conducted in the New York public schools in connection with the school lunch service of the Department of Education. It has been realized that something more must be done than merely provide good lunches for the children. Only about 9 per cent of the children avail themselves of the school lunches, for one reason or another. But even if a child consumed regularly the daily lunch at school, he would be taking fewer than 200 meals out of a yearly total of 1095 or more. This experience alone would scarcely be enough to establish the habits we have been speaking about, since in many cases his other meals at home would tend to destroy the good habits as fast as they were formed. The school lunch must be supplemented by very definite instruction in dietary hygiene.

In this nutrition "drive" the preliminary step of "propaganda" has been accomplished. The children's attention and interest in regard to food matters have been aroused by such means as slogans, posters, and "nutrition days." The Child Health Organization has even contributed a health clown, "Cho-Cho," who lent the glamour of the circus to the simple injunction to drink milk instead of coffee.

The next thing to do is to try to use the interest that has been aroused and teach the child more concretely just what a correct diet is. Dr. Gustave Straubenmüller, associate superintendent of schools, sent to the American Museum of Natural History a request for teaching material. To meet this demand the department of public health of the Museum in coöperation with the department of public education of the same institution has prepared a traveling exhibit for the public schools which it is hoped will constitute a real contribution to the cause of public health education. This exhibit consists of a set of sixteen wax models of foods suitable for the needs of a child between the ages of ten and thirteen, and a set of colored wooden blocks illustrating the composition of six common foods. It includes also eight wall charts.

Correct Diet Taught by Means of Food Models

The food models have been designed to be used in three different ways so as to give a fairly complete picture of the chief lessons of dietary hygiene. In the first place, each

Examples of Foods That Make Up a Healthful Diet for a Child from Ten to Thirteen Years of Age

NECESSARY TYPES OF FOOD	CALORIES SUPPLIED BY EACH TYPE		AMOUNTS THAT SUPPLY THE NECESSARY CALORIES
I. BREAKFAST.— *Total Calories: 400–600*			
Fruit	50–100	Apple	½ to 1
		or banana	½ to 1
		or orange	¾ to 1½
		or Malaga grapes	10 to 20
Cereal	100–150	Rolled oats or cornmeal	1 to 1½ cups cooked
		or flaked wheat or cornflakes	⅔ to 1 cup
		or puffed rice	1¼ to 2 cups
		or shredded wheat	1 to 1½ biscuits
Bread	50–100	Whole wheat or white bread	1 to 2 slices
Butter, or butterine	50–100	Butter, or butterine	½ to 1 tablespoon
Milk or Cocoa made with milk	100–150	Milk	⅔ to 1 cup
		or cocoa made with milk	⅗ to 1 cup
II. DINNER.— *Total Calories: 700–1200*			
Meat, fish or eggs	75–300	Lamb stew	1 to 3 small pieces, 1 to 3 oz.
		or piece of steak	1 to 3 pieces (2×1½×1 inches)
		or eggs	1 egg=70 calories
		or chicken	1 to 3 slices (2×4×¼ inches)
Potatoes, rice, macaroni, etc.	100–200	White potato	1 to 2 medium
		or sweet potato	1 to 2 small
		or boiled rice	¾ to 1½ cups
		or boiled macaroni	1 to 2 cups
Fresh vegetables	25–50	Spinach	½ to 1 cup
		or carrots	1 to 3 medium
		or turnips	½ to 1 cup sliced
		or tomatoes	½ to 1 medium
		or cauliflower	⅛ to ¼ head
		or cabbage	1¼ cups shredded=25 calories
Milk	100–150	Milk	⅔ to 1 cup
Bread	100	White bread	2 slices
Butter	100	Butter, or butterine	1 tablespoon
Pudding, or similar dish	200–300	Rice pudding or apple tapioca or cornstarch blancmange or Brown Betty pudding or ice cream	½ to ¾ cup
III. SUPPER.— *Total Calories: 400–800*			
Cream soup, or similar dish	200–300	Cream of tomato or celery or spinach or asparagus or pea or split pea or bean soup	1 to 1½ cups
		or mashed or creamed potatoes	1 to 1½ cups
		or boiled macaroni	2 to 3 cups
Bread	50–100	White or whole wheat	1 to 2 slices
Butter, or butterine	50–100	Butter, or butterine	½ to 1 tablespoon
Stewed fruit	100–200	Stewed prunes	about 2 to 5 prunes and 2 to 4 tablespoons juice
		or apple sauce	½ to 1 cup
		or stewed apricots	¼ to ½ cup
Cake	50–100	Plain cookies (2¼ inches diameter)	1 to 2
		or lady fingers	1 to 3
		or one-egg cake (two inch cubes)	½ to 1
Milk, or cocoa made with milk	100	Milk	⅔ cup
		or cocoa made with milk	⅗ cup

model represents a 100-calorie portion (or in some cases 50-, 150-, or 200-calorie portions) so that it gives the child a clear grasp of the conception that each food has its definite value as a source of energy for the running of the living machine.

In the second place, the models can be used to show the specific contributions made by each kind of food to the upbuilding of the body, for it is as essential to provide a sufficient supply of calcium and iron, of protein and vitamines, as to supply the total energy which the body needs for its daily activities.

Models of a sample menu for a child's midday dinner, including 1½ ounces of lamb (stew), 1 medium-sized potato, 1 cup of cooked spinach, 2 slices of whole wheat bread, 1 tablespoonful of butter or butterine, 1 cup of milk, and ½ cup of rice pudding. The portions also separately represent a heat value of 100 calories, except the spinach, milk, and rice pudding, which supply 50, 150, and 200 calories respectively. Such an exhibit tells a story which the children can readily understand, and makes clear to them the fact that food is not eaten merely because it tastes good, but rather to build up the body and supply energy for its work

This sample menu for a child's supper consists of 1 cup of cream of tomato soup (200 cal.), 2 slices of bread (100 cal.), ½ tablespoonful of butter (50 cal.), 5 prunes and 4 tablespoonfuls of juice (200 cal.), 1 cup of milk (150 cal.), and 2 cookies (100 cal.). The whole day's food, as represented by the samples illustrated, gives a total heat value of 2200 calories with 64.44 grams of protein, 1.356 grams of calcium, 1.495 grams of phosphorus, and 0.015 grams of iron. The diet of a child from ten to thirteen years of age—the preceding is only a characteristic sample—should always represent 1800 to 2500 calories; one third of these should be supplied from cereals and bread. Further, whatever the daily menu, the child of this age should always have a quart of milk a day, 3 or 4 tablespoonfuls of butter or similar fat, a cupful of fresh, cooked vegetables, 4 or 5 glasses of water, and fruit at one meal at least

Enjoyment of the Forest through Knowledge

By F. F. MOON

Acting Dean of the New York State College of Forestry, Syracuse University

TO most Americans, particularly those living in the cities, the forest is a closed book. Far from being a group of trees merely occupying a certain part of the landscape, the forest is in reality a community of trees having itself a life. Trees, shrubs, and ground-cover, the animal life which roams beneath the forest shade, the fungus and bacterial life of the forest soil—all together form the forest community. In view of the manifold subjects of surpassing interest which the forest affords, it should be the desire of every red-blooded American who loves the open to learn the ways of the forest: how it starts, how it develops, the names and habits of trees; how they, like individuals in the city, compete with one another for food and drink while affording one another protection.

The enjoyment of the green shade of a city park can be multiplied a hundred-fold by those who are fortunate enough to be able to hunt, fish, or camp in a real forest, and strange as it may seem, the fact that forests need to be developed and in some degree prepared for widest, fullest use as recreation areas is at present grasped by only a few. Roads and trails must be cut, camp sites selected and laid out with an eye to beauty and accessibility. Sanitary features must be provided. In short, the wilderness host presents a stern front to those guests who do not know its ways.

Fully to enjoy and profit by a camping experience or even a walk in the woods, one must be acquainted with the woods. Just as a boy or girl going to a new school or to a new town feels strange and ill at ease until he makes acquaintances, so one feels when going into a forest composed of trees and shrubs of whose identity he is ignorant. The first steps should be to know the principal trees and shrubs: to recognize them by their leaf and buds, also from their bark and general appearance. When these have been learned, a ramble among the trees is as enjoyable as a visit to the home of friends. The habits of the trees and their reaction to environment can then be studied. Every tree stands for something and has its definite part to play in the community. Those like the Norway pine, gray birch, and red cedar which are light-demanding and will quickly die if over-topped, will be found growing in the open or in pure stands unmixed with other trees. Others, like the beech, hard maple, or red spruce, which are "tolerant" of shade, will grow for some time beneath a comparatively close canopy made by the foliage of taller trees. The reaction of trees to soil and moisture conditions offers a particularly interesting study. Certain trees like the black walnut and white oak are found large and well developed only where the soil is deep and fresh. The pioneers in the Lake States were accustomed to locate on the land covered with good-sized beech and maple, since these trees indicated soil of agricultural richness. Other species prefer light to soil-fertility and moisture, and can soon be crowded out of the rich bottom lands by shade-enduring trees. This may explain why dry barren pastures may be found covered with a stand of gray birch and red cedar.

When the fact has been grasped that trees have their peculiarities like human beings, a study of the forest community, composed of trees and shrubs, becomes fascinating. Countless instances of the indomitable energy of the tree, its tenacity, its ability to adapt itself to circumstances, can be seen while strolling through the woods. The development of a tree community from a group of wind-sown pine seedlings on abandoned pasture to a splendid stand of pine trees, straight of bole, clear of branches, really constitutes an epic. It is a struggle for existence and the survival of the fittest, an inspiration to those who have eyes to see and a heart to understand. The forest holds many a lesson which the discerning eye can read.

Trees as Friends

It is a pleasure to publish the following extracts through courtesy of the Editor of the *Journal of the New York Botanical Garden*, from Dr. W. A. Murrill's very charming mention of some of the world's best known trees. It brings to mind anew the particular trees which have come close to our own personal experience and thought, especially those connected with our childhood, and emphasizes anew the realization that familiar acquaintance with nature gives a broader and more gracious and generous view of life.

"THE children of the Orient have the bamboo, the ginkgo, the teak, the banyan, and the oriental plane; those of Syria the ancient olive trees and cedars of Lebanon. The children of Norway have the Norway maple, and the Norway spruce; those of Sweden, who live in the very home of Christmas, have also beautiful firs and birches. The Germans love their lindens and horse-chestnuts and fill their fairy stories with references to fir trees; the Swiss children spend their summers on the Alpine pastures surrounded by tall and stately firs and spruces; the Austrian children find the larch on the mountains and a beautiful species of pine in some of the valleys, from the wood of which they carve their Christmas toys; the Italian children, even in the crowded streets of Venice and Naples, cannot fail to know something of the chestnut and olive orchards on the mountain slopes and the pollarded willows of the lowlands. The children of rural France love the long rows of poplars that shade the highways, and those of the cities love their beautiful parks and shaded boulevards; the London lad occasionally turns his eyes from his cricket bat to gaze upon a majestic field elm or a grove of oaks or beeches, while the farmer's boy loves to linger in the shade of the elms and oaks that everywhere dot the English landscape."

"In Cuba, children play beneath wide-spreading laurel trees and royal palms; while in Mexico girls and women loiter and wash their clothes beneath the willows that fringe the streams, or gather wild fruits and flowers under oaks and Montezuma pines. Every child in Mexico City knows the grove of giant cypress trees adjoining Chapultepec and 'La Noche Triste' tree, under which Cortez reviewed his shattered army. The children of California boast of the giant redwoods, still the largest of all trees in spite of rival claims; while those of Washington and Oregon know red firs and other trees almost as large. The boy of the southern United States delights in the magnificent oak, chestnut, and pine forests, and in the beauty and perfume of the southern magnolia; while the boy of the North glories in 'the murmuring pines and the hemlocks' and the valuable forests of maple, beech, and birch."

"In studying history, art, literature, mythology, and the customs of various peoples, a child finds many references to trees and tree lore. If we add to these sentiments and fancies some definite and accurate knowledge of the more common trees in one's locality, together with the life history and needs of trees in general, it means a much broader and happier life for the child and man. Trees will then never be forgotten, but will be recognized and loved as the faces of friends."

Notes

ON February 1, Dr. Robert Cushman Murphy comes to the American Museum as associate curator of ornithology. He will devote his time particularly to a study of the collections made by the South Pacific Expedition; publication of reports upon zoölogical material collected along the east and west coasts of South America is also contemplated.

It may be remembered that some years ago (1912–13) Dr. Murphy went to South Georgia on an expedition conducted jointly by the American Museum and the Brooklyn Museum. The observations and collections made on this trip laid the foundation for his future work on sea birds in particular and oceanic zoölogy in general, which have now become important branches of his studies.

Among other expeditions made by Dr. Murphy was one to Lower California in

1915, while his latest investigations have been among the guano islands along the Peruvian coast of South America.

Dr. Frederic A. Lucas is nearing the tenth anniversary of his directorship of the American Museum and the fortieth anniversary of his service to the museums of America. In celebration of this event the American Museum has in mind the publication of a selected series of his papers on museums and museum administration, together with a brief autobiographical sketch and bibliography of his writings for the last forty years.

The president, trustees, and scientific staff of the American Museum sent their greetings and felicitations on the occasion of the formal opening of the Institute de Paleontologie Humaine in Paris on December 23. The great service to anthropology which this institution has already accomplished is a monument in the history of science which points the way to a bright future of discovery and achievement. The institute was inaugurated by S. A. S. the Prince of Monaco in 1910 for the study of early man and his works. Under its auspices a number of researches have been carried on, notably in certain of the caves in Spain.

The American Association of Museums has appointed a committee consisting of Mr. L. V. Coleman, chairman, and Dr. E. O. Hovey, of the American Museum, and Mr. H. L. Madison, of the Park Museum, Providence, to report at the Cleveland Convention in 1921 on a plan for classifying museum information and providing for its distribution. It is planned to organize the subject matter of museum technique, administration, and activity on a decimal basis and to arrange for publishing data on loose leaves.

We regret to record the death on October 8 of Dr. Yves Delage, professor of zoölogy at the Sorbonne and director of the Roscoff Marine Station in France. Professor Delage was preëminent among French zoölogists for his knowledge of shore fauna and his experimental work on parthenogenesis. More than twenty volumes of *L'Année Biologique* stand as a monument to his industry, as well as six volumes of the *Traité de Zoologie Concrète* and many other books, including his notable work on *Heredity and the Great Problems of General Biology.*

An expedition to Greenland for the further exploration of the north coast regions, including Peary Land, will be undertaken in 1921 as a fitting bicentenary commemoration of the first colonization of Greenland by Hans Egede in 1721. Dr. Lange Koch will lead the party which in the late summer will carry supplies by Cleveland tractors across the ice-free marginal zone at Inglefield Gulf to Warmings Land on the north coast. In the two years following, Dr. Koch will journey by dog sledges with Polar Eskimos. The cost of the expedition is being defrayed by the Danish government and a committee of prominent Danish gentlemen, including Professor Eugene Warming.

The completion of Knud Rasmussen's study of the Greenland Eskimos is reported by Mr. W. Elmer Ekblaw in the *Geographical Review.* Rasmussen returned late last year from Ammassalik on the east coast. He now knows every Eskimo in Greenland personally and has made an exhaustive study of the language, customs, and folklore. He is himself part Eskimo and was born in Greenland, but later studied languages and ethnology at the University of Copenhagen. His life has been devoted to this anthropological study which he hopes will ultimately comprehend all of the race from Ammassalik to Siberia.

The statement frequently made that the Hawaiian race is disappearing is erroneous, according to Mr. Louis R. Sullivan, assistant curator of anthropology in the American Museum. Mr. Sullivan is at present making an anthropometric survey in the Hawaiian Islands in coöperation with the Bishop Museum of Honolulu. Although the native stock is rapidly becoming mixed, he estimates that there are at least 20,000 representatives still to be found. In his anthropometric work Mr. Sullivan has received active coöperation from the people of the territory who willingly presented themselves for examination. He has found the average height of the Hawaiians to be 5 feet, 8¼ inches, which is exceeded only by the Scotch with an average height of 5 feet, 8½ inches. Mr. T. C. White, representative of the Bishop Estate in the district of Kona, accompanied Mr. Sullivan for a month, rendering valuable assistance through his wide acquaintance among the Hawaiians.

The week after Christmas was as usual convocation week, and the American Association for the Advancement of Science and a number of other scientific societies met in Chicago. Dr. Frank E. Lutz presided at the meetings of the Entomological Society of America and Dr. E. O. Hovey was present as secretary of the Geological Society of America. Dr. E. H. Moore, professor of mathematics in the University of Chicago, was elected president of the American Association to succeed Dr. L. O. Howard; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, the retiring president, gave the presidential address, his topic being "Twenty-five Years of Bacteriology—A Fragment of Medical Research."

Physical anthropology, as the name implies, deals with the material side of man, his bodily characters, such as size and color, shape of the head, character of the hair, points wherein one man or race differs from another. Among other matters it includes detailed measurements of the human body and their relationships to one another, the object being to determine resemblances or differences between individuals or races of mankind, a branch of science termed anthropometry—the measuring of man. Now, in order to have uniformity in measurements so those taken by one worker may be accurately compared with those taken by another, or with those taken by the same worker at different times, certain definite points have been agreed upon by anthropologists. These are usually located where the underlying bones come near the surface, sometimes the bones or joints themselves are chosen, not only because these points are well marked, but so that measurements of the skeleton may be compared with those made on the outside of the body, for sometimes bones only are available, and sometimes measurements must be made on living men.

These selected points are shown in an exhibit prepared under the direction of Mr. L. R. Sullivan and recently placed in the southwest pavilion on the second floor of the American Museum. So far as we know this is the first piece of its kind. It is a life-sized figure of a man showing on the one side the outer part of the body and on the other the skeleton—the points selected for measurements being indicated by labels.

The technique of cephalometry, the detailed measurement of the head and face, is shown in a case near by which includes a set of labels giving a brief history of the subject.

A meeting preparatory to the foundation of the Institut International d'Anthropologie was held at the Ecole d'Anthropologie of Paris, September 9–14, 1920, in accordance with a circular letter sent out by the school on November 20, 1918. The aim is to found a permanent international organization among all the anthropologists of the allied nations with a central office for the arrangement of periodic sessions, the facilitation of relations between investigators, the centralization of publications, and the development of plans of research in physical anthropology, prehistory, ethnology, and other branches. Dr. Charles Peabody, of Harvard University, was the American delegate. A provisional executive council was elected of which S. A. I. Mgr. le Prince Bonaparte is president. Doctors Clark Wissler, of the American Museum, Aleš Hrdlička, of the U. S. National Museum, G. G. MacCurdy, of Yale University, and Charles Peabody, of Harvard University, are the American representatives on the council.

The Intercollegiate Cosmopolitan Club of New York City was the guest of President Henry Fairfield Osborn at the American Museum on January 4, 1921. The club is comprised of foreign students who are studying in various collegiate institutions of the city and represents more than sixty nationalities, including Latin America and the Far East as well as many of the European countries. These men and women from the four corners of the earth are absorbing American ways of life and ideals in connection with their academic studies and for that purpose they are brought together by the club in a semisocial way. As the aim of the club is to express the common brotherhood of man, Dr. G. Clyde Fisher appropriately spoke on the interrelations and interdependence of all human life in connection with a special exhibition of the film on "How Life Begins."

Following this lecture the guests made an excursion through various halls of the museum, after which tea was served in the hall of the Age of Man.

A NEW theory of the origin and racial affiliation of the Polynesian peoples was proposed by Dr. Roland B. Dixon, professor of anthropology in Harvard University, in a paper before the American Philosophical Society on April 22.[1] Professor Dixon has reinvestigated all available data, not alone with reference to the cephalic index but also with reference to a correlation between the cephalic index, length-height, and nasal indices, and, whenever possible, the facial index. The conclusions that he reaches are that the primitive underlying strata in the Polynesian area was Negrito. This was followed by a Negroid people such as now inhabit Melanesia and Australia, while the Negritos only survive in remote marginal areas. After the Negroid peoples came a Malayoid or Mongoloid race which absorbed and submerged the preceding types. As the anthropometric data is very scanty, these conclusions can only be regarded as a tentative hypothesis on which more light will be shed by the investigations now under way under the auspices of the Bishop Museum in Honolulu.

DR. RALPH S. LILLIE has resigned his professorship of biology in Clark University to accept the position of biologist in the department of pure science of the Nela Research Laboratories, National Lamp Works of the General Electric Company. He will, however, retain his connection with the Marine Biological Laboratory at Woods Hole, Massachusetts.

THE field of anthropology has been almost entirely lacking in books of a general and introductory type such as would place the principles of the science before the beginning student or the worker in related sciences such as sociology, history, and comparative jurisprudence. Dr. Robert H. Lowie, associate curator of anthropology in the American Museum, has undertaken to supply this lack in the special branch of social organization, and his recent work, *Primitive Society,* constitutes an excellent introduction to social anthropology for the student or interested layman. The author takes up the topics of marriage, kinship, the position of women, property, associations, government, and justice, and outlines the characteristic forms in which each have been found among primitive groups. Dr. Lowie adheres to the historical as opposed to the evolutionary school of anthropology. "The existence of uniformity in cultural history," he says, "cannot be assumed simply because it would be convenient. . . . If there are laws of social evolution, he (the anthropologist) must assuredly discover them, but *whether* there are any remains to be seen . . . Without, therefore, at the outset renouncing the search for laws of social evolution, we will emphatically declare our independence of that pseudo-scientific dogmatism which insists on formulating all phenomena after the fashion that has proved serviceable in a diminutive corner of the field of human knowledge. Uninfluenced by any bias for or against historical regularities, we shall attempt to determine what are the facts and what has been their actual sequence."

DR. CHARLES-EDWARD A. WINSLOW, curator of public health in the American Museum and professor of public health in Yale University School of Medicine, will assume the directorship of the public health activities of the League of Red Cross Societies at Geneva in February. Dr. Winslow expects to return to the United States before the opening of the fall term next October.

DR. HENRY E. CRAMPTON, curator of invertebrate zoölogy in the American Museum, now on an extended expedition to the Orient, reports a very successful trip.

His first period of field work comprised two months devoted to Guam and Saipan in the Mariana Islands. Guam, which is well known as our naval station, is a composite island geologically, as it is formed in part of ancient sedimentary strata much metamorphosed, and in part of uplifted limestone reefs. The island is very interesting in connection with studies of distribution, for certain land mollusks of the genus *Partula* extend to it and to its neighbors, although they are more strictly Polynesian in their habitat. The natives, called Chamorros, are allied to the Filipinos in part. The success here was largely due to the governor,

[1] *Proc. Amer. Philos. Soc.,* Vol. LIX, 1920, p. 261.

Captain Ivan C. Wettengel, U. S. N., who granted many unusual favors and made it possible for Dr. Crampton to proceed by naval vessel to Saipan. Here also the collections were particularly rich in several groups, especially insects.

On August 26 Dr. Crampton sailed for Manila. Through the coöperation of the Philippine Bureau of Science he secured on the island of Luzon a fine series of photographs and from Dean Baker, of the College of Agriculture at Los Banos, a full series of reptiles and amphibians and a large series of named insects. Governor Harrison was much interested in the expedition and placed a coast guard steamer at Dr. Crampton's disposal in order that he might cross Manila Bay to the Mariveles Mountains and see the pygmy natives of that region. On this trip, however, Dr. Crampton was most unfortunately kicked by a vicious horse and was forced to return for treatment.

About the middle of September he sailed for Hong Kong whence he continued up the Canton River to the Canton Christian College. Here at the invitation of the faculty, he delivered a series of lectures on evolution and on Polynesia and its peoples. The zoölogist of the college, Professor Howard, is developing a campaign of systematic collecting in the Canton region which is certain to be exceptionally successful.

Late in September Dr. Crampton took steamer to Bangkok. A few days were spent there in making preparation and then he proceeded to his long-determined goal, the city of Chieng-mai, five hundred miles to the north, where for a few weeks he was the guest of His Serene Highness, Prince Bovarädej, viceroy of northern Siam. Numerous favors were extended and Dr. Crampton was privileged to learn a great deal of the Lao people of this region and of their highly developed culture.

The city of Chieng-mai is beautifully situated on a plain of rice fields, surrounded on almost all sides by mountains of considerable height. Nearly a week was spent in the forests high up on the mountain of Doi Sutep at an elevation of 2700 feet. The American Presbyterian Mission has Rest Houses at different places on Doi Sutep and these were placed at Dr. Crampton's disposal.

On November 8 he started by rail for Singapore, taking several days for the trip down the Malay Peninsula and collecting around Penang and Kuala Lumpus. Thence he sailed to Java on November 19 for a period of field work on that island.

Mr. H. E. Anthony, associate curator of mammals in the American Museum, reports from Ecuador unusual success in securing valuable material. Mr. Anthony, together with Mr. G. K. Cherrie, has been enjoying the hospitality of the South American Development Company, at one of whose mining camps, Portovelo, a base has been established. From here they have collected throughout the southern Andes almost as far as Peru, obtaining about 1200 birds and 640 mammals. This is the largest collection of mammals the American Museum has ever made in South America. The expedition will continue into the eastern Andes and the little known headwaters of the Amazonian drainage system and will subsequently make a cross section of the mountains farther north. Mr. Anthony also plans a reconnaissance for fossils along the west coast.

The last island in the West Indies to be thoroughly investigated, and perhaps the most interesting island of all, from a biological standpoint, is Santo Domingo. The American Museum has received a number of collections from this island. Perhaps the most recent contribution is a series of reptiles and amphibians made by Lieut. J. K. Noble, United States Marine Force, Air Service, and his associates in the First Squadron, Aviation Unit stationed at San Pedro de Macoris, Santo Domingo. A number of photographs taken from an airplane show the possibility of panoramic representation of life zones, so interesting to the students of zoögeography and so clearly marked off on the slopes of most tropical mountains, especially those of the central highlands of Santo Domingo. In a future number of Natural History Mr. Rollo H. Beck will narrate his experiences while bird collecting in Santo Domingo.

The "Lepidoptera of the Congo, Being a Systematic List of the Butterflies and Moths Collected by the American Museum of Natural History Congo Expedition, together with Descriptions of Some Hitherto Undescribed Species" has just been published by Dr. W. J. Holland, director of the Carnegie Institution, in the *Bulletin of the American Museum.* The collection, which is one of the largest from the region in recent years, is especially rich in the larger and showier species characteristic of the territory covered. It contains nearly 9000 specimens representing more than 725 species and varieties.

Mr. A. K. Haagner, director of the National Zoological Gardens of South Africa at Pretoria, was the guest of the American Museum on September 21, and delivered an address in the auditorium, illustrated by lantern slides and moving pictures. Mr. Haagner gave an account of the circumstances that rapidly led to the practical extinction of many large South African mammals, such as the blesbok, springbok, white-tailed gnu, white rhinoceros, hippopotamus, and Cape giraffe. In this process of extinction the development of transportation facilities has been a vital factor; the automobile, the motor-boat, and the railroad have finally supplanted the porters' caravan, ox wagon, and "Cape-cart." As a result, most of the larger animals now exist only in reservations, which are often privately owned.

A pleasant surprise was an account of the success attained in breeding wild animals in the Pretoria zoölogical gardens, in part made possible by the relatively mild climate in that region. Conspicuous in this respect were the fine herds of the greater kudu, the Rhodesian cob, South African eland, and buffalo. Among the carnivores successfully bred was a litter of the spotted hyena, suckled by a domestic dog; the quaintest were the young of the long-eared fennec fox.

A splendid film of a herd of elephants, originally taken to illustrate one of Rider Haggard's stories, brought great applause. The huge animals seemed only slightly disturbed on leaving the forest and after entering a remarkably picturesque parkland they scattered among the palm groves. Their actions and grouping often changed and the artistic effect of the picture was heightened by the presence of a great flock of cow-herons which circled over them, some alighting on the elephants' backs. Following a charge across the open veldt, the largest tusker fell to the skill of a hunter and his bushman tracker.

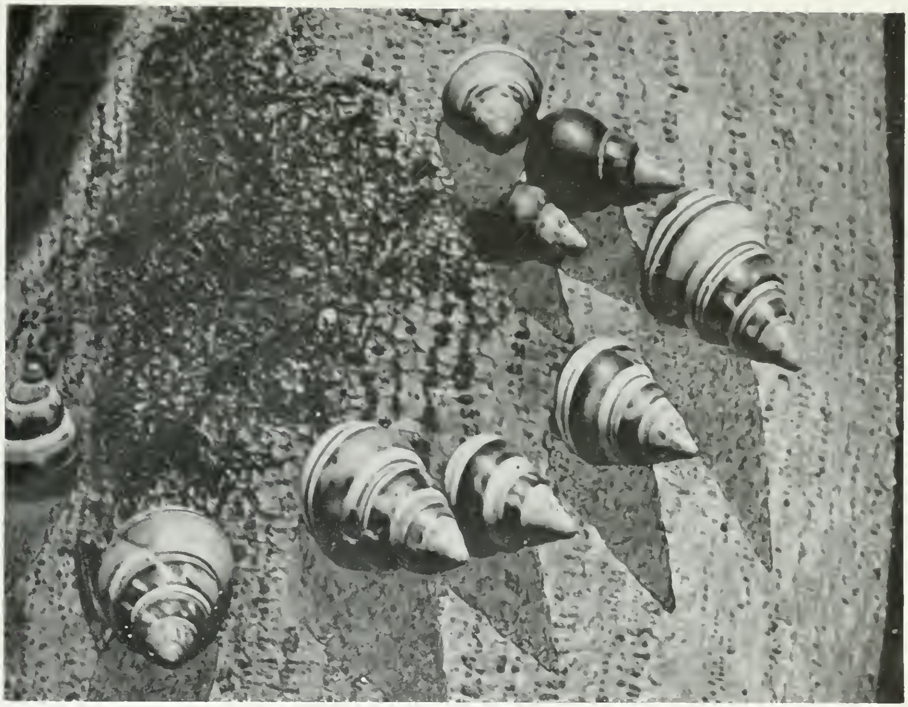
Mr. Haagner has presented to the American Museum a fine skin of the rare mountain zebra which was taken in the Cradock District in the mountains of the Southeastern Cape Colony and which through an accident had perished on the way to America.

The great moonfish or opah (*Lampris luna*) is one of the strangest fishes of the sea and so unique structurally that it constitutes an order (Selenichthyes) by itself. It is a large fish reaching a weight of four hundred pounds and is characterized particularly by the extraordinary development of the shoulder girdle which is proportionally many times larger than in other fishes. Dr. David Starr Jordan now reports a fossil species of *Lampris* from the diatom bed of Lompoc, California.[1] The specimen is about 3 by 2 feet and is "of great interest as showing the antiquity of one of the most singular of all living fishes, and incidentally with other associated forms, the relative age of the present fish fauna of California."

The use of the sucking fish (*Echeneis* or *Remora*) for catching other fish was first reported by Columbus and has since been both affirmed and denied by travelers and scientists. Dr. E. W. Gudger, in a series of articles in the *American Naturalist,* collects all the written evidence and actual experiments with *Echeneis,* which tend to show that the method was feasible. The method was to fasten a line around the fish's tail. With its powerful sucking apparatus the *Echeneis* would then attach itself to another fish and the latter could be hauled in and netted. Dr. Gudger estimates from experiment and calculation that an *Echeneis* might stand a pull of about fifty pounds or greater. This pull is sufficient for landing even large fish which are frequently taken with lines breaking at less than thirty pounds dead pull.

The United States Department of Agriculture has undertaken the investigation of the effect of poisonous plants on grazing animals with the ultimate aim of preventing losses from this source. There are more poisonous plants in the United States than is generally supposed (one list gives 25,000 species). Field stations have been established by the department in localities where the investigators can have immediate access to poisoned stock.

[1] "An Ancient Moonfish." *Scientific Monthly,* Vol. XI, 1920, p. 470.

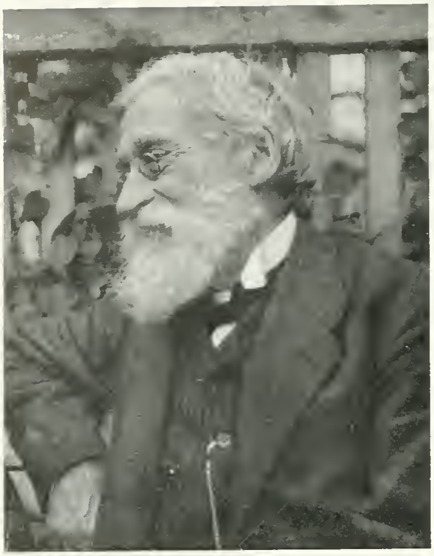


Photograph by John K. Small
Courtesy of G. P. Putnam's Sons

Arboreal snails (*Liguus fasciatus*) æstivating on the trunk of a Jamaica dogwood on Long Key, Everglades. These richly painted mollusks are among the rapidly disappearing fauna of Florida. Their doom is sealed in the destruction of the hammocks by the white man, whose very presence seems fatal to them

THE veteran naturalist, Mr. Charles Torrey Simpson, during more than twenty years of residence and travel in southern Florida, has collected a wealth of observations on the wild life, geography, and geology of that state which he now presents in a volume, *In Lower Florida Wilds*. Mr. Simpson lived on the southwest coast of the peninsula from 1882 to 1886 and explored the tropical wilderness when flamingos and spoonbills, deer, otter, and alligators were yet abundant. The book is a valuable record of a life now in great part passed away. During these many years the author penetrated into the remote Everglades, protected from the curious by swamp-land and sword grass; he explored the ragged coral-bound islands of the coast, and hunted through the once primeval forests. He is particularly interested in the causal features in the natural history of Florida—the origin of the land and the differences of fauna and flora, separated at times by only a few miles of swamp or sea. The presence and distribution of tropical animals and plants Mr. Simpson attributes for the most part to the current of the Gulf Stream rather than to a land bridge or the agency of birds. Among the beauty spots described in the book the most notable are perhaps the hammocks or areas of hardwood trees and rich tropical vegetation. Their great enemy, aside from man, is fire which, strange to say, seems ultimately to benefit the pine woods. Except for the live oaks which he calls the "Achilles of the hammocks" the hammocks would not exist. The pioneer work of this remarkable tree is accomplished by its rapid growth, great resistance, and dense shade which make it a defense against the fires and a blight over the pines. But in a hammock once well established the tropical flora ultimately takes root and the live oak, which has made possible their growth, succumbs to the stifling embrace of the common strangler (*Ficus aurea*).

Mr. Simpson makes an appeal for the preservation of the wild life and forests of these hammocks before it is too late. "They should be cherished for their beauty and for the rare vegetation they contain. Once destroyed they can never be replaced quite as nature has made them, and Florida would be despoiled for all time of one of her most important attractions."



Dr. Franz Steindachner, 1834–1919, renowned ichthyologist and director for fifty years of the Natural History Museum in Vienna

Dr. Franz Steindachner was born in 1834. As a young man he was associated with Agassiz at Cambridge, making collections of fishes for him or with him in California and in Brazil. In the fifties he was called to the K. K. Naturhistorischen Hofmuseum in Vienna, of which he became director (intendant) about 1870, succeeding Dr. Rudolph Kner. As head of this museum he devoted his personal energies to the upbuilding of an extensive collection of fishes, publishing with great regularity a series of papers on the different groups which he studied. These papers are remarkable for their accuracy, especially shown in the description of species, and all were illustrated by the fine lithography of his inimitable artist, Edouard Konopicky. Steindachner was interested especially in details, leaving to others, and usually less careful workers, the great generalizations of his science. With Linnæus he held, *Tyro fit classes, magister species.* "The beginner defines classes, it takes a master to deal with species."

Steindachner's first paper, on the fossil fishes of Austria, appeared in 1859. The last which has reached me is on certain fishes of Brazil and was passed by the British censor as politically safe in 1915.

When the Imperial Government razed the fortress wall of Vienna, they established the Burgring on its site, and from the proceeds of sales founded a Gallery of Paintings, an Opera House, and the Museum of Natural History of which Steindachner became director. But he received scant funds for his work. Outside his artist, taxidermist, and the janitor service, practically the whole expense fell on him. He wrote labels for the specimens and at least a large part of the material received was paid for from his own funds. I find that this was true of the collections I sent him from the West Indies and the Pacific.

Dr. Steindachner never married. He lived in very modest fashion in rooms attached to the museum, where I visited him in 1913. He was a man of medium height, slender and wiry, wearing a full brown beard, silvered with age,—a delightful personality, quiet, modest, and intensely devoted to his museum and his studies.

One of the most terrible results of the war has been its abasement of science with the sufferings it has entailed on scientific workers in central and eastern Europe, the regions where, in Hoover's words, "Human life is worth about three cents."

Steindachner died on December 10, 1919, at the age of 85. His successor, Dr. Victor Pietschmann, writes me that he died of cold, there being no coal obtainable to heat the museum or his own apartments.—David Starr Jordan.

The production of light by animals has always proved a phenomenon exciting admiration and has given rise to much physiological speculation and research. Dr. E. Newton Harvey, professor of physiology in Princeton University, has recently published a monograph on bioluminescence, treating of the underlying physical characteristics and chemical processes in animal light.[1] Dr. Harvey concludes that the luminescence of at least three groups of animals (the beetles, *Pholas*, and *Cypridina*) is due to the interaction of two substances, luciferin and luciferase, in the presence of water and oxygen. Luciferase is a protein substance which behaves in many ways like an enzyme and is used up in large quantities in the oxidation of luciferin in the formation of light. This problem has also been studied extensively

[1] E. Newton Harvey, *The Nature of Animal Light* (Monographs on Experimental Biology), 1920.

by Prof. Ulric Dahlgren, who will contribute an article on the subject to a future number of NATURAL HISTORY.

IN order to provide for the organization of an institute for research in tropical America the National Research Council through its Division of Biology and Agriculture has appointed a committee on organization and incorporation consisting of Messrs. A. S. Hitchcock, of the Smithsonian Institution, and J. W. Toumey, of Yale University, and Doctors D. S. Johnson, of Johns Hopkins University, F. M. Chapman, of the American Museum, Thomas Barbour, of the Museum of Comparative Zoölogy, and W. J. Holland, of the Carnegie Museum, representing the organizations especially interested in the establishment of such an institute.

THE New York Zoölogical Society is organizing a campaign for the protection of the fur-bearing mammals of the world against inroads now being made by the fur trade. A forthcoming number of the *Zoölogical Bulletin* will be devoted to an article prepared by Director William T. Hornaday on this subject. It seems probable that the age of mammals is literally drawing to a close and that by the middle of this century there will be no mammals left except in the game preserves. Even in the preserves great inroads are being made from time to time, as we learn in a letter recently received from South Africa from the secretary of the Society for the Preservation of the Fauna of the Empire. The secretary writes:

"We had a very bad case before us last week, which shows how great is the need for awakening interest in faunal protection at the present time. A game drive on a large scale was organized by about sixty settlers in Zululand, and in defiance of the game laws, with the connivance of the Natal Provincial Council, they rounded up vast numbers of game in the Umpolozi Reserve, and slaughtered them wholesale, leaving the carcasses to rot. About 3000 head of big game were killed, mostly zebra, but including at least two of the last ten white rhinoceroses left in South Africa. The excuse was the prevalence of ragana in the area. As it is now the opinion of the greatest experts on the tsetse that the slaughter of game is quite useless as a preventive measure unless all living things, great and small, be exterminated in the area, it seems all the more deplorable."

THE New York Zoölogical Garden reported the birth of a chimpanzee on July 14, 1920. The event was noteworthy in that this is the second chimpanzee known to have been born in captivity. As the literature on the subject of the breeding of anthropoid apes is small, the accounts by Dr. W. Reid Blair in the *Zoological Society Bulletin* and *Zoopathologica* are of considerable scientific interest. The mother unfortunately was unable to nurse her offspring, and it lived but eight days.

THE great length of time which a hippopotamus can remain under water without coming to the surface for air has been noted in the case of a specimen in the London Zoological Gardens. This animal, timed by his keeper, remained submerged in clear water for 29 minutes. The hippopotamus, "Guy Fawkes," which died in the same garden in 1905, is also credited with a long immersion under unusual circumstances. A dog which one day strayed into his enclosure was furiously pursued into the water tank and crushed in the jaws of the hippopotamus. The latter seemed very much disturbed by the occurrence, and the next day when the enclosure was opened he plunged to the bottom of the tank. After half an hour the keeper, supposing that the animal was dead, prepared to drag the tank to recover the body, whereupon the hippopotamus rose again to the surface.

THE American Ornithologists' Union held its annual meeting in Washington from November 8 to 11. It was one of the most largely attended meetings in the history of the Union, with one half of the total number of fellows and 10 per cent of the entire membership present. A feature of the occasion was an exhibition of illustrations of birds by American artists and a series of prints showing the evolution of ornithological illustration from the earliest times. Dr. Witmer Stone, curator of the Academy of Natural Sciences of Philadelphia, was elected president for the ensuing year. Six papers were read by the following members of the staff of the American Museum: Dr. F. M. Chapman and Messrs. W. DeWitt Miller, J. P. Chapin, and Ludlow Griscom.

THE continuation of Major Charles Bendire's monumental work on the life histories of North American birds has been undertaken by Mr. Arthur Cleveland Bent. Mr. Bent has published the first section as "Life Histories of North American Diving Birds—Order Pygopodes," with illustrations from numerous photographs of habitats and nests and fifty-five color plates of eggs.[1] Unfortunately, for reasons of economy, it was not found possible to bring Mr. Bent's volume — especially the plates — up to the standard of Bendire's work. Mr. Bent includes the hitherto unpublished reports on Arctic bird life of the Crocker Land Expedition in so far as they relate to his group, together with photographs made by members of the expedition.

THE discovery of a sculpture dating from 1561 of the extinct dodo is recorded by Dr. A. C. Oudemans from the town of Vere on the little island of Walcheren, Zeeland. This is the oldest known representation of the dodo, which became extinct in the seventeenth century. Dr. Oudemans considers it a good figure, modeled after an actual specimen. He has compiled a monograph (in Dutch) on the dodo, its anatomy, habits, distribution, and the literature thereon, and publishes therewith a series of rare or forgotten illustrations, including photographs of the Vere sculpture. A good reproduction of this giant, awkward, aberrant pigeon may be seen in the hall of birds of the world in the American Museum.

THE first engagement in the fight to maintain Malheur Lake Reservation, Oregon, as a wild-life sanctuary has been lost by the forces in favor of conservation. In November the people of Oregon voted down a bill, initiated to give a clear title to the United States Government to the land and water rights of this tract. Malheur is a shallow lake about fifteen miles long by nine wide, surrounded by marshy land which, it is believed, is the greatest breeding ground for wild fowl in the country. It was set aside by executive order of the late President Roosevelt in 1908 "for the use of the Department of Agriculture as a preserve and breeding ground for native birds." Under the proposed law it would have been rechristened "The Roosevelt Bird Refuge," but for a number of years certain promoters with eyes only for commercial exploitation have been urging the state of Oregon to bring legal proceedings to get control of the reservation in order to drain the lake and sell the land for agriculture. Already the lake is on the verge of drying up as a result of the diverting of most of the waters from the Silvies and Blitzen rivers for irrigation. The proposed law would have corrected this situation in part and have given positive title to the Federal Government.

Myriads of water fowl have been accustomed to breed here—Canada geese, mallards, redheads, pintails, gadwalls, cinnamon teal, ruddy ducks, California and ring-billed gulls, night herons, great blue herons, Farralone cormorants, white pelicans, three species of grebes, bitterns, rails, avocets, stilts, phalaropes, snipe, kildeers—and the lake is the only place in Oregon where the white heron or American egret, which in 1908 was all but extinct, is to be found. Two colonies of this most beautiful of American plumage birds were discovered near the lake in 1919 by Mr. William L. Finley, field agent for the Audubon Society, and, given opportunity, they would no doubt become numerous again. The land which might be salvaged by the drainage of Malheur Lake region, as was reported in NATURAL HISTORY for December, 1919, has been shown by investigations of the United States Biological Survey to be too alkaline for anything but coarse grass. No economic development of any importance can result from destroying this ancient home of the birds. There is no other spot among the arid lands where they can raise their broods, and the citizens of eastern Oregon fail to realize that the birds themselves are an asset, not only from the æsthetic and natural history point of view, but in dollars and cents as measured by the protection they afford to crops from insect pests and in the maintenance of a legitimate game supply. There is still possibility that through prompt action by the Federal Government this bird sanctuary may be spared. Bird lovers and sportsmen all over the country should give the matter wide publicity and do all they can to bring about the creation of a permanent Federal reservation.

APROPOS of the recent article on the redwoods in NATURAL HISTORY a member of the staff of the American Museum who visited the western coast last summer writes: "Of

[1] Smithsonian Institution. *Bulletin* 107, 1919.

the routes covered none seemed at the time more beautiful or made a more lasting impression than the ride from Grant's Pass, Oregon, to Eureka, California, a two days' trip, much of it through the wildest and most wonderful forest region still remaining in America. On the second day, after leaving the cleared area about Crescent City and climbing the steep hills which nearly everywhere along that coast extend to the ocean shore, the traveler sees little of civilization and little of the effects of human destructiveness. The road winds among hills and ravines densely clothed with a magnificent redwood forest, the great trees growing in places in dense, nearly pure stands, but more often intermingled with tall firs and hemlocks and, farther south, with Sitka spruces and lowland white firs, which are often scarcely less impressive than the redwoods. At times the highway comes out on the bare bluffs bordering the Pacific, affording a view out over the ocean and the white surf breaking far below. But the most impressive feature of the trip is the long stretch of almost absolutely wild and undamaged forest, through which the road passes, and the magnificent size and height of its constituent trees. The mountainous country, the remoteness from large centers of population, and the lack of good harbors along the coast have alone saved this region up to the present time; they cannot save it much longer. If prompt action is not taken, all this natural beauty will be destroyed in order that a few people may make money out of what should be the property of all."

In 1895 when the New York State Legislature put the beavers under absolute protection it was estimated that there were not more than five or ten individuals in the state. This year the Conservation Commission estimates that in the Adirondacks alone there are 15,000 or 20,000 of these animals. From virtual extermination in the state the beavers, under twenty-five years' protection, have increased to such an extent that measures are being considered for their restriction. The beaver in times past was an important economic asset and was hunted for its valuable pelt. The animals, however, are very destructive to trees, cutting down large numbers for use as food and to construct their "houses," and flooding large areas with the dams they build. Last year the Conservation Commission supported a bill providing a short open season, but it failed of action. The annual increase, amounting to about three thousand animals, might well be taken and would yield a considerable cash dividend.

Evidence of a recent world-wide sinking of the ocean level to the extent of about twenty feet is presented by Dr. Reginald A. Daly, professor of geology in Harvard University, in the June number of the *Geological Magazine*. Professor Daly offers his own field observations and marshals a large amount of published data to show the presence of a strand about twenty feet above high tide, dating from post-Glacial times. As there is no evidence warranting the belief that the ocean basin has been sufficiently enlarged in recent times to admit of this change, Professor Daly proposes the hypothesis that the lowering of the sea level has resulted from the increase in thickness of existing nonfloating glaciers and ice caps. For example, a sinking of this extent would result if the Antarctic ice cap were thickened by about seven hundred feet.

The part played by military geologists on the Western Front has recently been officially summarized by Mr. Alfred H. Brooks, formerly chief geologist on General Pershing's staff. Mr. Brooks points to a number of hopeless enterprises, expensive in lives, that were undertaken because the responsible officers failed to take account of the geological factors. The principal applications of geology were the determination of underground and surface-water conditions and the physical character of the soil, subsoil, and bed rock, with special reference to field-works and the determination of road material and the influence of soil and subsoil during wet and dry seasons on the movement of troops. It was also found that the geologic conditions affecting electrical transmission entered into the use of listening devices such as were extensively used in trench warfare. The value of geologic knowledge to an army in the field became so evident as the war went on that toward its close nearly all the powers had organized geological staffs.

At a symposium before the Geological Society of America on the teaching of geology and palæontology Professor Charles

Schuchert, of Yale, read a paper on "American Palæontologists and the Immediate Future of Palæontology." Professor Schuchert estimates that there are but 37 invertebrate and 17 vertebrate palæontologists and 4 palæobotanists actively engaged in constructive work in North America. The great shortcomings and restriction of palæontology are due, Professor Schuchert thinks, to its dominance by the geologists especially in the universities. Historical geology should be taught by palæontologists rather than by geologists. The invertebrate palæontologists have further been dominated by geological interests in that about 90 per cent of their work is chronogenetic while the biological aspects of the subject have been allowed to pass into the background.

Evidence for a former land connection between Patagonia and Australia by way of the Antarctic Continent has long been seen in the presence and restriction to these two regions of the frogs of the family Leptodactylidæ. It has, however, been maintained by some that this distribution was merely a case of convergent evolution. The latter hypothesis is definitely excluded and the existence of the land bridge established, according to Dr. Maynard M. Metcalf, by the discovery in the two branches of Leptodactylidæ of closely similar species of parasite (*Zelleriella*).[1] These parasites are in turn confined to South America and Australia. That both similar frogs and similar parasites should have arisen together by parallel evolution in remote quarters of the earth would seem unlikely.

Dr. Leon A. Hausman, who recently contributed an article on "Mammal Fur under the Microscope," has just published in the *American Naturalist* a much more extended paper, with numerous illustrations, on "Structural Characteristics of the Hair of Mammals." This work of Doctor Hausman's emphasizes the fact that there is plenty of work at hand for him who has his eyes open. It may be recalled that microscopic structure of hair has now and then played an important part. About fifty years ago a murder trial in England hinged on the question of blood and hair adhering to a knife. The defendant claimed that this came from a rabbit that he had skinned, but microscopic examination showed that the blood corpuscles were human in their character and that the hair was not that of a rabbit but of a squirrel, and the murdered woman had worn a tippet made of squirrel's fur.

The application of statistical methods to meteorological data has been made in order to determine the effects of various kinds of weather on crops during various stages in their development, to calculate the risk from unfavorable weather, and to correlate the weather relations over various parts of the country. Mr. Thomas Arthur Blair, meteorologist in the United States Weather Bureau, reviews the progress in the United States of this new branch of meteorology in a recent number of the *Scientific Monthly*.[2] An example of the results achieved may be seen in the determination made by Professor J. Warren Smith that the yield of corn in Ohio is dependent upon the rainfall during June, July, and August. The difference between three inches of rainfall in July and five inches means the difference in yield between 30 and 38 bushels an acre, or 27,300,000 bushels for the state. One half inch of rainfall less than 3¼ inches reduces the state crop by 15,000,000 bushels, and each quarter of an inch increase between 2 and 4 inches adds an additional $7,800,000 to the crop. Closer calculation indicates that the critical period for corn in Ohio is during the first ten days in August. This is the time when the extra rain must fall, if a big crop is to result. Such determination of critical periods is of great importance in practical agriculture inasmuch as the climate of most of the United States is known in detail and accordingly it may be predicted whether a specific crop is climatically adapted to a particular locality. Further, inasmuch as the development of a crop can be advanced or retarded within limits, the time of its arrival at a critical period may be controlled to a certain extent and the proper stage of development caused to occur at a time when favorable weather conditions are most likely to exist.

The plant and animal life in a fresh-water pond, with especial reference to roti-

[1] "Upon an Important Method of Studying Problems of Relationship and of Geographical Distribution." *Proc. Nat. Acad. Sciences*, Vol. VI, 1920, p. 432.

[2] "The Mathematician, the Farmer and the Weather." *Scientific Monthly*, Vol. XI, 1920, p. 353.

fers or wheel animalcules, will be depicted in a companion study to the Bryozoa group at the American Museum. Field work is at present in progress in southern New Jersey under Mr. Roy W. Miner in coöperation with Mr. Frank J. Myers, who has recently been appointed a research associate in the American Museum.

SYSTEMATIC trapping of birds for banding is far more productive of results than merely banding young birds in the nest, according to Mr. S. Prentiss Baldwin[1] who reports on four years' experience in this work. The birds regarded the traps as feeding stations and showed no fear. By the extensive capture of adults in this way a large number of records of birds returning to their last year's feeding grounds was obtained. Mr. Baldwin considers the chances are about one in five that a migrant will return to the same locality to winter. Information may also be supplied by this means of the routes birds follow in migrating and the length of time they spend at various feeding grounds on the way.

THE progress in the purchase of eastern national forests during the last nine years is reviewed in the August number of *American Forestry*. By the Weeks Law of 1911 provision was made for the protection of the headwaters of navigable streams by the maintenance of forests. The original appropriation was for $11,000,000 to which $3,600,000 has since been added. Under this act 1,841,934 acres of spruce and hardwood have been or are being acquired at an average price of $5.26 an acre. These purchases represent the only provision so far made for conserving the timber supply of the eastern states and are of especial importance as they include hardwoods practically limited to these states. There are about 30,000,000 acres of hardwood and spruce land in the East unsuited for agriculture, which should be maintained for all time as productive forest.

AT the invitation of the government of the Republic of Haiti, Mr. W. P. Woodring and several other representatives of the United States Geological Survey have gone to that island to conduct a geological reconnaissance.

THE Rockefeller Foundation reports that during 1919 its activities in public health and medical education have been carried on in twenty-five countries besides the United States.[2] "The war against disease is a world war." There is no use purifying one community, if its neighbors remain a constant source of infection. The foundation has been pushing the fight against yellow fever into its strongholds in South and Central America and Africa. Dr. Hideyo Noguchi, of the foundation's staff, has apparently isolated the infecting organism of this fever. Attacks were also continued against the malarial mosquito in the southern states and against the hookworm disease in remote corners of the world. An exhaustive bibliography on the latter disease is now nearing completion and will, it is hoped, be published soon. In France the campaign against tuberculosis was continued and extended. The largest work of the foundation—as measured financially—is the introduction of Western medicine into China through the medium of the China Medical Board. A modern medical center is being raised in Peking where premedical, medical, and graduate study will be offered and a standardized hospital maintained for clinical study, training of nurses, and as a model for imitation by the Chinese. Three of the school's buildings were occupied in October, 1919, and the whole plant will be ready by January, 1921.

A TIMELY publication on the races of Russia has been written by Dr. Aleš Hrdlička,[3] giving an account of the origins and characteristics of the Russians. This people which is essentially Slav is increasing at a rapid rate, more rapid than the increase of any other large branch of the white race, and so bids fair to become one of the predominating factors in the Europe of the future.

THE American Museum of Natural History is to receive an unconditional bequest of $15,000 from the estate of Mrs. Fanny Bridgham.

[1] S. Prentiss Baldwin, "Bird Banding by Means of Systematic Trapping." *Abstract of the Proceedings of the Linnæan Society of New York.* For the Year ending March 11, 1919. No. 31, 1919.

[2] George E. Vincent, *The Rockefeller Foundation: A Review for 1919*, New York, 1920.

[3] *Smithsonian Misc. Coll.* Vol. LXIX, 1919, No. 11.

An exhibition of paintings of birds by Mr. Courtenay Brandreth was recently held at the American Museum. The exhibit will be reviewed by Dr. Frank M. Chapman, curator of ornithology, in a future number of Natural History.

The library of the American Museum has continual inquiry for back numbers of the American Museum Journal and Natural History, and urges that those subscribers who have copies which are no longer needed will send them to the Librarian. They may be sent by express, collect.

Mr. Donald B. MacMillan, leader of the Crocker Land Expedition of 1913, announces that this spring he will start on another two-year trip to the Arctic for scientific investigations.

The second and last volume of *Wild Flowers of the State of New York*, by Homer D. House, state botanist, has just been received. The most notable feature of the work is the extraordinarily fine series of color plates illustrating most of the species. A more comprehensive illustrated review of the volumes will be given in a future number of Natural History.

A history of American state geological and natural history surveys has been compiled by Dr. George P. Merrill, head curator of geology in the United States National Museum.[1] North Carolina, it appears, inaugurated the first geological survey with an appropriation of $1250 in 1824. This was undertaken during spare time by Professor Denison Olmsted, of the State University, who had urged it upon the legislature as an economic measure. The results of Professor Olmsted's work were published in two booklets of 44 and 60 pages respectively.

To Massachusetts, however, belongs the credit for the first really comprehensive survey, undertaken and carried to completion. It was begun in 1830 under Professor Edward Hitchcock, of Amherst, assisted by a corps of naturalists in other branches than geology. Other states soon followed, so that, by the end of the Civil War, thirty-three had carried forward surveys to a greater or less degree.

[1] Smithsonian Institution. *Bulletin* 109, 1920.

Dr. G. A. Boulenger, curator of reptiles and amphibians in the British Museum (Natural History), recently issued a revision of the family Lacertidæ with special reference to specific variation. The monograph combines a number of years' research some of which has already been published elsewhere. This is Dr. Boulenger's last work in his official capacity at the British Museum, from which institution he has withdrawn in order to take up botanical researches in the Gardens in Brussels. A brief bibliographical notice of this monograph of the Lacertidæ appears in the *Annals and Magazine of Natural History* for December. The author of that note comments on Boulenger's retirement in the following words: "All zoölogists must regret that the most distinguished of living herpetologists is no longer officially connected with the unrivaled collection which he has done so much to build up."

The curatorship in plant pathology has been established at the Brooklyn Botanic Garden and provision will be made early in 1921 for an experimental greenhouse and grounds. Dr. George Matthew Reed, pathologist in the office of cereal investigation of the United States Department of Agriculture, and previously assistant professor in botany at the University of Mississippi, has been appointed to this position. In 1916–17 Doctor Reed spent eight months at the Brooklyn Botanic Garden and during that time made a study of the diseases of the trees and plants of Prospect Park and the Botanic Garden, the results of which were published in the *Record* for January 1917–18. In addition to his research work, Doctor Reed will act as curator of the Cryptogamic Herbarium and will have general oversight of plant diseases in the conservatory and plantations.

Dr. C. S. Sherrington, professor of physiology in Oxford University, was elected president of the Royal Society on November 30. Professor Sherrington is the leading authority on the physiology of the central nervous system. In 1906 he delivered the Silliman Memorial Lectures at Yale University and on the text of these lectures was based his most notable published work, *The Integrative Action of the Nervous System.*

A TABLET to commemorate the discovery by Dr. Hideyo Noguchi of the yellow fever organism has been ordered placed in the laboratories of the Public Health Department of Guayaquil, Ecuador, by the municipal authorities. Dr. Noguchi made this discovery while pursuing researches in these laboratories for the Rockefeller Foundation.

THE annual meeting of the New York Academy of Sciences was held in New York City on December 20. Baron Gerard De Geer, of Stockholm, Sweden, addressed the meeting on "How and Where To Determine the Pleistocene Time Scale in the United States and Canada," and Dr. Robert Cushman Murphy spoke on "The Natural History of the Humboldt Current and the Islands of Peru." Dr. Edward L. Thorndike, professor of educational psychology in Columbia University, was reëlected president of the society for the ensuing year.

THE American Meteorological Society held its first annual meeting in Chicago on December 29. The presidential address was delivered by Professor Robert DeC. Ward on "Climate and Health, with Special Reference to the United States."

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patron, MRS. A. H. BRAWNER.

Fellow, MISS MARY CYNTHIA DICKERSON.

Life Members, DOCTORS JOHN A. FORDYCE, GEORGE M. MACKENZIE, MESSRS. C. MONTAGUE COOKE, JR., GEORGE M. DEXTER, WALTER F. DILLINGHAM, HARRY HARKNESS FLAGLER, ROBERT S. KILBORNE, PIRIE MACDONALD, CHARLES A. MAURICE, E. E. SMATHERS, and RICHARD WELLING.

Sustaining Members, MESSRS. CHARLES STRAUSS and FRANK D. WILSEY.

Annual Members, MESDAMES THOS. GARRETT, JR., H. E. GIBB, WM. S. GORDON, SAMUEL HAMMERSLOUGH, EUGENE HODENPYL, EDWIN C. JAMESON, DWIGHT A. JONES, JOHN T. SMITH, PAUL STARRETT, JOS. EARLE STEVENS, HERBERT K. STOCKTON, ROBERTS WALKER, MISSES MARY DOHERTY, CHARLOTTE REGESTER, RUTH LANGDON ROGERS, M. W. SHAW, DOCTORS ALBERT R. LAMB, VICTOR C. PEDERSEN, MESSRS. CHARLES DEXTER ALLEN, HAROLD B. ATKINS, A. C. BEROLZHEIMER, RAYMOND BILL, CHAS. E. BRYANT, L. J. CALVOCORESSI, WINTHROP CHANLER, JOHN GRANT DATER, WILLIAM S. DENISON, H. DE WETTER, GEORGE D'UTASSY, ALFRED FRANK, WILLIAM O. GAY, ARTHUR GREENBERG, FRANK E. HAFF, HERMANN HAGEDORN, H. L. HARTSHORN, PAUL M. HERZOG, VICTOR R. HESS, WALTER S. HILBORN, JOSEPH E. HOFFMAN, LAURENCE C. HOLDEN, HENRY A. HOVET, CHARLES E. HUGHES, JR., FREDERICK W. JACKSON, J. EDWARD JETTER, C. H. KEEP, D. EMIL KLEIN, LOTHAIR S. KOHNSTAMM, CLAUDE W. KRESS, ALEXANDER H. KRIDEL, LOUIS KROWER, VITUS C. LAMBERT, CLINTON H. LEGGETT, HAROLD M. LEHMAN, MOE LEVY, ROBERT LISSAUER, PHILIP LIVINGSTON, MAURICE LOBSITZ, ALBERT C. LUDLUM, E. L. LUEDER, WM. M. MACFARLANE, K. MANDELL, HENRY METCALFE, JULIUS PRINCE, GAVIN ROWE, ISIDOR S. SCHWEITZER, A. J. SELIGMAN, A. RANGER TYLER, L. L. WINKELMAN, G. BYRON WOOLLEY, and the WASHINGTON SCHOOL.

Associate Members, MESDAMES G. S. J. OLIVER, JOHN C. OLMSTED, MISSES T. MAE MACNAB, KATHERINE E. H. VAN WINKLE, DOCTORS LEWIS B. AMSBRY, ROSWELL P. ANGIER, WILLIAM WALLACE CAMPBELL, I. C. CHASE, A. P. DURYEE, D. H. GALLOWAY, OLIVER E. GLENN, H. LEIGHTON KESTEVEN, HERBERT W. RAND, L. D. RICKETTS, ALBERT HAZEN WRIGHT, THE REVEREND JAMES M. OWENS, PROFESSOR C. OLIVER SCHNEIDER, MESSRS. E. J. ARMSTRONG, HORACE W. BABCOCK, DON O. BAIRD, M. A. BECK, FRED M. BULLARD, HAROLD O. BURDICK, HENRY M. CANBY, THOS. CANTLEY, CHARLES C. CARSON, FRANCIS B. COOLEY, T. G. DABNEY, ERWIN A. ESPER, LAURENZ GREENE, HOFFMAN R. HAYS, WILLIAM HURD HILL, ERWIN P. HILTS, CHARLES C. JACKSON, OWEN W. KENNEDY, A. M. LINDSAY, JR., HARVEY HARLOW NININGER, C. M. PALMER, C. S. PARKER, CARROLL CHURCHILL PERRY, JR., HAROLD SHARP, W. MOSELEY SWAIN, W. G. SWART, ROY M. WHELDEN, and RALPH WILLIAMS.

INDEX OF VOLUME XX

Names of contributors are set in small capitals