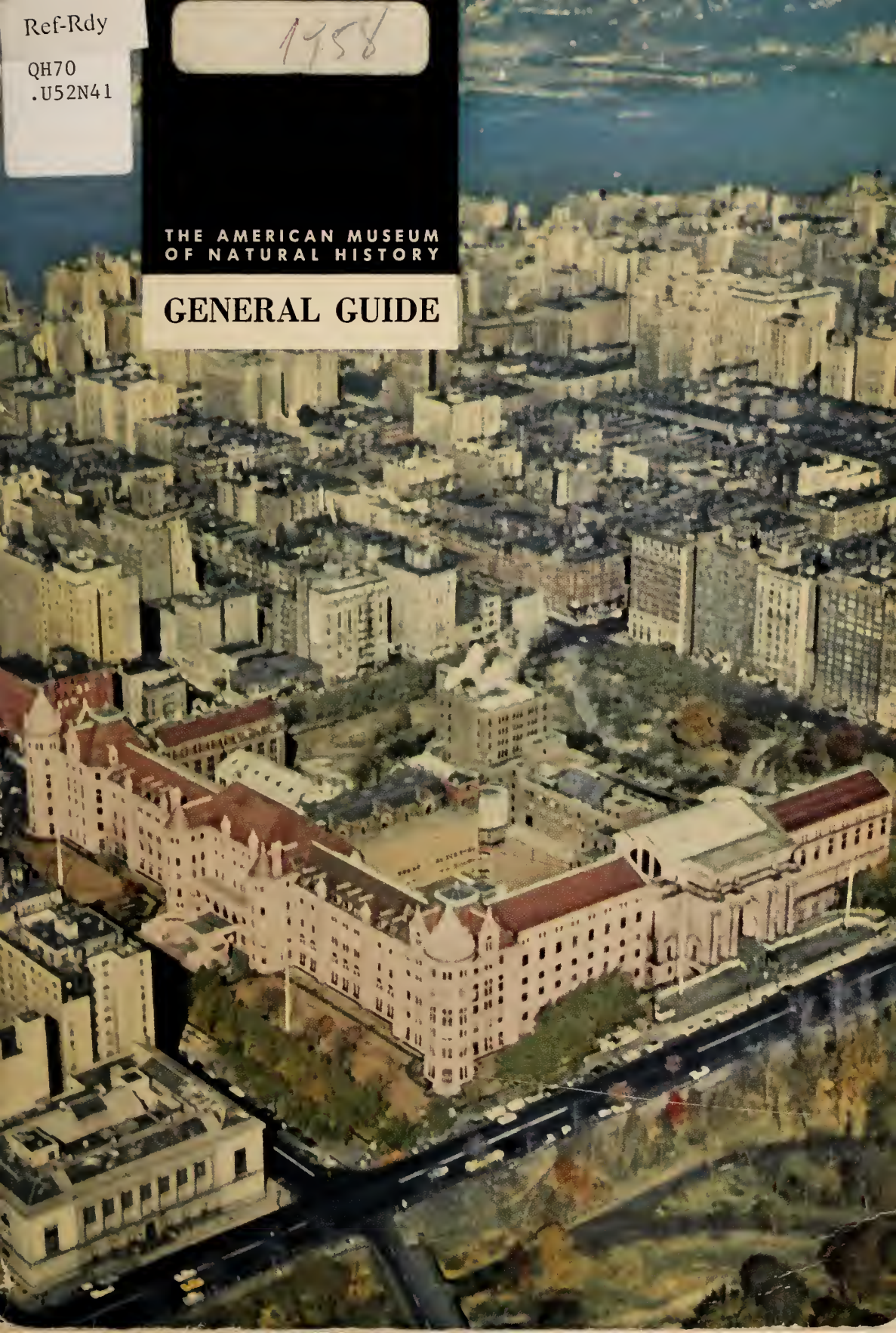
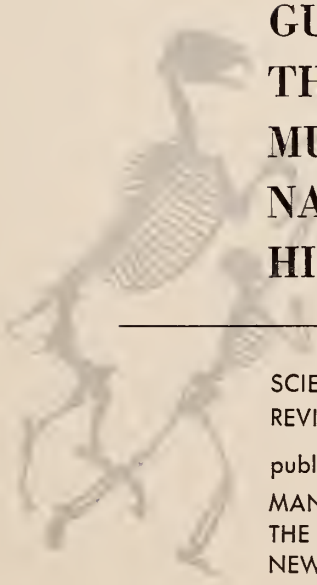
THE AMERICAN MUSEUM
OF NATURAL HISTORY

GENERAL GUIDE





GENERAL GUIDE to THE AMERICAN MUSEUM of NATURAL HISTORY

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REVISED EDITION

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THE AMERICAN MUSEUM OF NATURAL HISTORY
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Exterior of The Theodore Roosevelt Memorial Building Central Park West—Equestrian Statue of Theodore Roosevelt by James Earl Fraser

Cover Photograph by Lee Boltin

contents

nature—the environment of man

AN INTRODUCTION TO THE AMERICAN MUSEUM OF NATURAL HISTORY

The ideal museum has been dreamed of but has not yet been built. The ideal museum presents, in logical order, the entire story of the universe, the earth, and its inhabitants, together with their total relation to each other. Practical limitations prevent such a museum from becoming a reality but the goal is there.

The American Museum of Natural History works constantly toward that goal. A study of the Table of Contents of this General Guide will give the Museum visitor a key to an appreciation of its offerings in both a logical and a chronological order.

Astronomy mirrors the universe and states the theories of the earth's origin. The hardened rocks furnish the material of geology and the life-forms trapped in that rock are the objects of the paleontologist's search. From fossils we advance to forms that are familiar today — living creatures without backbones, insects, fishes, reptiles, birds, and mammals — all leading to the study of man himself.

With the growth of man from primitive savagery to what we call civilization, come changes in his relation to his surroundings. The first living thing was affected by its environment and affected it in turn. Man is no exception. He is one of a species of animals, among which he is no more necessary to the continuance of life than are the insects, the birds or

the dinosaurs. His very existence in the future may depend on his understanding of the world in which he finds himself.

Man is still a part of nature, although he controls much on earth. He is still subject to great basic laws and forces that restrict and restrain him within marked boundaries. A shift in climate from marine temperate to glacial cold could wipe out the traces of man and his works over a continent. A movement of the ocean bed could send a tidal wave to destroy coastal towns thousands of miles away.

Closer to man's fate than great earth changes are the difficulties he makes for himself through lack of understanding of the consequences of his acts. Because he is the only living organism with the powers of reason developed to a relatively high degree, he is able to engage in thought-processes and actions that create in him needs and desires that were not shared by his early ancestors. In the satisfaction of these needs and desires he cuts down whole forests for his industries. He mines the soil and uses up resources he cannot hope to replace. He waters the desert and reaps his harvest. He plows the plains and sows the dust bowls.

The Museum is aware of the urgency of the problems of soil, water, forest, mineral and wild life conservation and of the conservation of man himself. As you read through this General Guide or walk through the Museum halls, note the theme expressed by those who represent the many departments of science and of education. This idea is plain in their research, in their writings and in their exhibits for the public. The scientist-educator is concerned with the interpretation of nature rather than with its mere presentation. The day of the thousand stuffed animals in one long case is gone. The scientist-educator knows that man must see nature as a whole since he must live as a whole being within its framework.

The American Museum of Natural History is one of the most wonderful places in the world. It houses the priceless objects of the earth, displayed in dramatic settings that amaze and delight all who come to see.

But it is more, much more, than a treasure trove of the rare, the exotic, the beautiful and the unusual. It is a great teacher who can tell man what has gone before, what exists in the present, and what the future holds, depending on man's choice of direction. It would not be a great teacher if it did not indicate the best direction for him to take.

The Museum should be all things to all men. It should meet the needs of the housewife, the farmer, the industrialist, the teacher, the college student, the child. Each must find, among its offerings, an answer to his questions, an understanding of daily living and an appreciation of his own place in a highly complex and interrelated world.

Unless museums work toward that objective, they fail in their obligation to mankind. This museum realizes that responsibility and asks you, the visitor, to pass judgment on the fruits of its labors and to take some of those fruits with you.

general information

general information

The American Museum of Natural History is located in Theodore Roosevelt Park and occupies most of the space between Central Park West, Columbus Avenue, 77th Street, and 81st Street. The main entrances are on Central Park West, through the Roosevelt Memorial, at three levels: street, vehicle (driveway under the steps) and subway. There is also an entrance on West 77th Street (foot and vehicle) in the center of the block.

The Planetarium may be entered from West 81st Street (foot and vehicle) and through the Museum. Cars may be parked at the curb on the streets surrounding the Museum Square or in the Planetarium parking area.

ADMISSION

There is no charge for admission except to the American Museum-Hayden Planetarium. The Museum is open to the public from 10:00 A.M. to 5:00 P.M. daily except Sundays, New Year's Day, Lincoln's Birthday, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Election Day, Armistice Day, Thanksgiving Day and Christmas, when it opens from 1:00 P.M. to 5:00 P.M.

MEMBERSHIP

There are about 90 thousand members of the American Museum of Natural History who believe that the Museum is doing a useful service to science and to education and who are contributing to this work. Through its explorations the Museum brings together rare and valuable collections from all over the world. It makes these wonders of nature easily available through its exhibition halls, its lectures, its work with school children, and its publications. The continuance and growth of this work is, in large measure, dependent upon the contributions of friends.

The Trustees invite you to lend your support by becoming a member.

Membership blanks may be obtained at the information desks, in the American Museum Shop, or by dropping a postcard to the Membership Secretary, The American Museum of Natural History, Central Park West at 79th Street, New York 24, N. Y.

Memberships may start at any time. Associate, Annual, Sustaining, Contributing and Supporting memberships continue for a full year's period from the date annual dues are paid. Life and higher class memberships are valid throughout the lifetime of the member.

The various classes of membership, with the dues payable by and the privileges accorded to each class, are as follows:

Class	Dues
Associate	yearly....$5
Annual	yearly....15
Sustaining	yearly....25
Contributing	yearly....50
Supporting	yearly...100
Life	300
Associate Patron	1,000
Patron	5,000
Associate Benefactor	10,000
Associate Founder	25,000
Benefactor	50,000
Endowment	100,000

Privileges

1. A Membership Card.
2. A year's subscription to *Natural History* magazine.
3. Ten per cent discount on all books and gifts on sale in the American Museum Shop.
4. Admission to the Members' Room.
5. A copy of the President's Annual Report on request (Life and higher class members receive the Annual Report automatically).
6. Two admissions yearly to performances of the American Museum-Hayden Planetarium.

7. Admission to all Members' Lectures (10 or more annually), with guest tickets permitting members to invite one guest to each lecture.

8. Admission to all Lectures in the Adventure Series for children of members (10 or more annually), with two guest tickets for each lecture.

9. A handsomely engraved Certificate of Membership, suitable for framing, for life membership and higher classes.

10. Admission to special staff functions arranged for higher class members.

11. Monthly Calendar of Events, Annual and higher.

HOW TO REACH THE MUSEUM

By Bus: Eighth Avenue or Columbus Avenue Bus to 77th Street. 79th Street Crosstown Bus to 81st Street and Central Park West.

By Subway: Broadway-Seventh Avenue Line to 79th Street and Broadway Station (local stop). Walk two blocks east to Columbus Avenue and 77th Street.

Sixth and Eighth Avenue Lines to 81st Street Station (local stop).

Lexington Avenue Line to 77th Street Station (local stop). then Crosstown Bus from East 79th Street directly to 81st Street and Central Park West.

Groups coming by bus should direct the bus driver to let them out at the 77th Street entrance. Busses can be parked in the area next to the American Museum-Hayden Planetarium. When leaving, busses should pick up their groups at the 77th Street entrance.

CHECK ROOMS AND GUEST SERVICES—INFORMATION DESKS

There is a limited checking service on weekdays and no checking on Saturdays, Sundays, and holidays. The main check room is on the right as one enters the main entrance on the first floor of the Roosevelt Memorial (driveway under the steps). Wheel chairs are available free of charge. There is also a check room at the left of the 77th Street entrance.

Information desks are located on the main (second) floor of the Roosevelt Memorial, in the 77th Street foyer, and facing the entrance to the Eighth Avenue subway.

THE AMERICAN MUSEUM SHOP

The entrance to the American Museum Shop is near the 77th Street entrance, next to the elevators. Unusual gifts from all over the world — authentic examples of native handicraft, pottery, masks, Indian silver jewelry, dolls and carved objects — are on sale. Specimens for the shell and mineral collector are kept in stock. A representative selection of books, covering the many fields of the natural sciences, may be purchased.

FLOOR PLANS

Pictorial plans of the Museum exhibits are posted near the elevators and at convenient points throughout the Museum to guide visitors to the various halls. Also see Index.

SKETCHING AND PHOTOGRAPHING

Chairs for artists and students who wish to draw from exhibits may be had by asking the nearest attendant. Amateur photographers may take pictures in the Museum halls. Professional photographers may get permission from the Division of Photography. The use of a tripod and careful exposure with a light meter is recommended for most Museum photography.

GUIDING

Free Guiding Service: In addition to the regularly scheduled educational programs of the Department of Public Instruction, free guiding is given to Members of the Museum and their friends, upon presentation of Members' tickets. An appointment should be made at least two weeks in advance, stating the day and hour desired, the number to be guided and any special exhibits to be seen.

Paid Guiding Service: This is available for non-members of the Museum according to the following schedule:

1-4 persons	minimum charge $2 per hour
4-9 persons	$2 per hour plus 50¢ each additional person up to and including 9 persons
10-30 persons	$5 per hour
30-60 persons	$10 per hour (services of 2 Museum instructors)
60-90 persons	$15 per hour (services of 3 Museum instructors)

Guiding is available on weekdays after 2 P.M. There is no guiding on Saturdays, Sundays and holidays. For appointments call TRafalgar 3-1300, Extension 255.

CAFETERIAS

The Main Cafeteria is convenient to the subway entrance in the Roosevelt Memorial. It is open from 11:30 A.M. to 4:30 P.M. daily and from 1:00 P.M. to 4:30 P.M. on Sundays. It is closed on the following holidays: Christmas Day, New Year's Day and Thanksgiving Day.

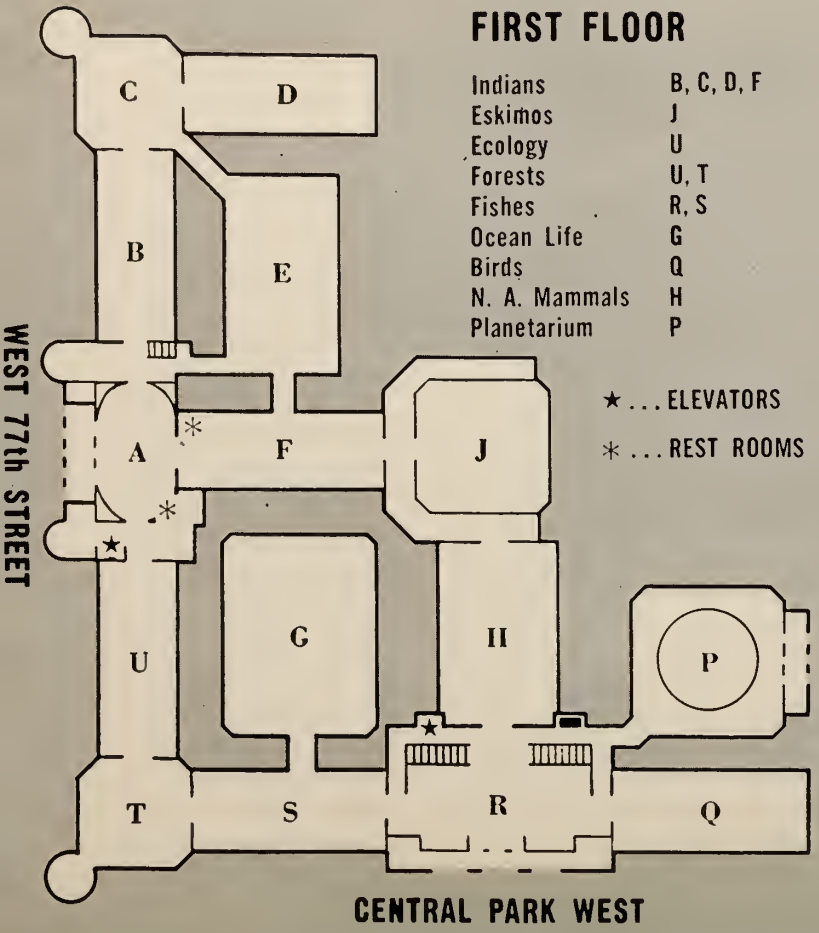
The Snack Bar, located in the basement of the School Service Building, is open every Saturday from 11 to 2:30 p.m. for those with package lunches. Museum visitors are not permitted to take their own lunches into the Main Cafeteria.

FIRST FLOOR

Indians	B, C, D, F
Eskimos	J
Ecology	U
Forests	U, T
Fishes	R, S
Ocean Life	G
Birds	Q
N. A. Mammals	H
Planetarium	P

★ . . . ELEVATORS

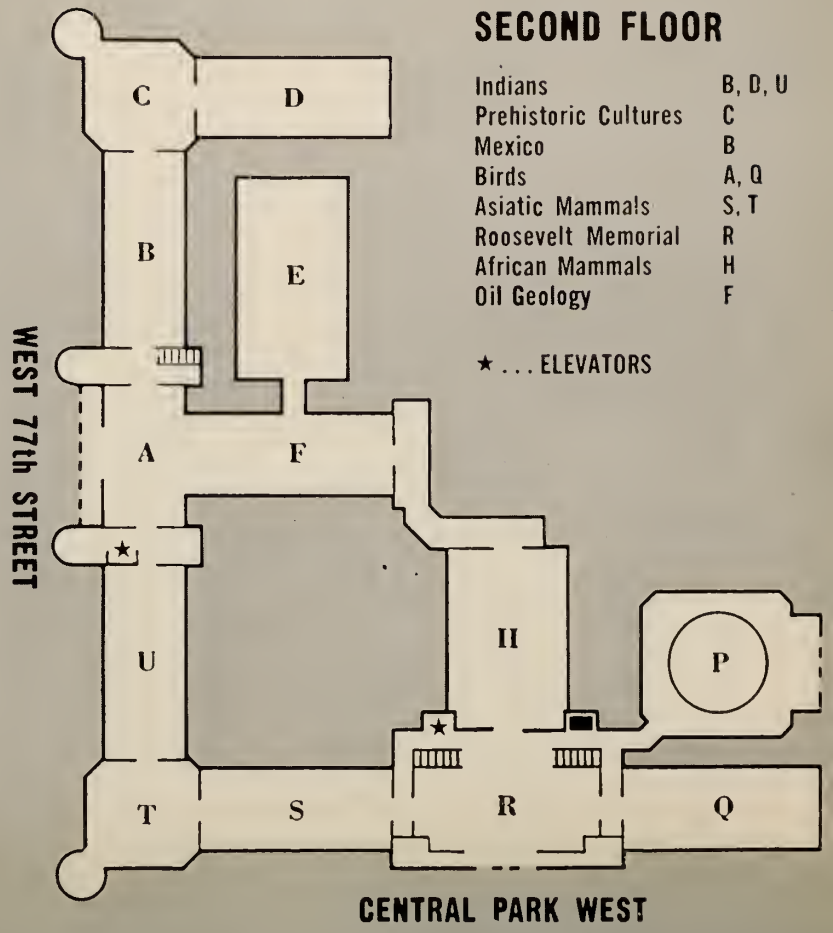
✳ . . . REST ROOMS



SECOND FLOOR

Indians	B, D, U
Prehistoric Cultures	C
Mexico	B
Birds	A, Q
Asiatic Mammals	S, T
Roosevelt Memorial	R
African Mammals	H
Oil Geology	F

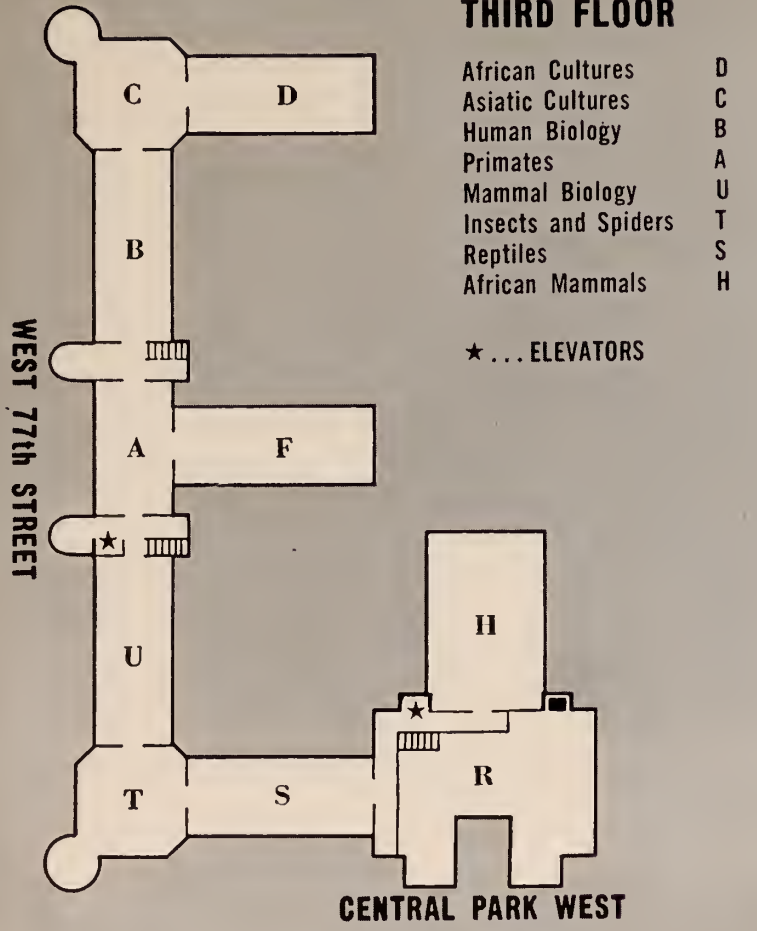
★ . . . ELEVATORS



THIRD FLOOR

African Cultures	D
Asiatic Cultures	C
Human Biology	B
Primates	A
Mammal Biology	U
Insects and Spiders	T
Reptiles	S
African Mammals	H

★ . . . ELEVATORS

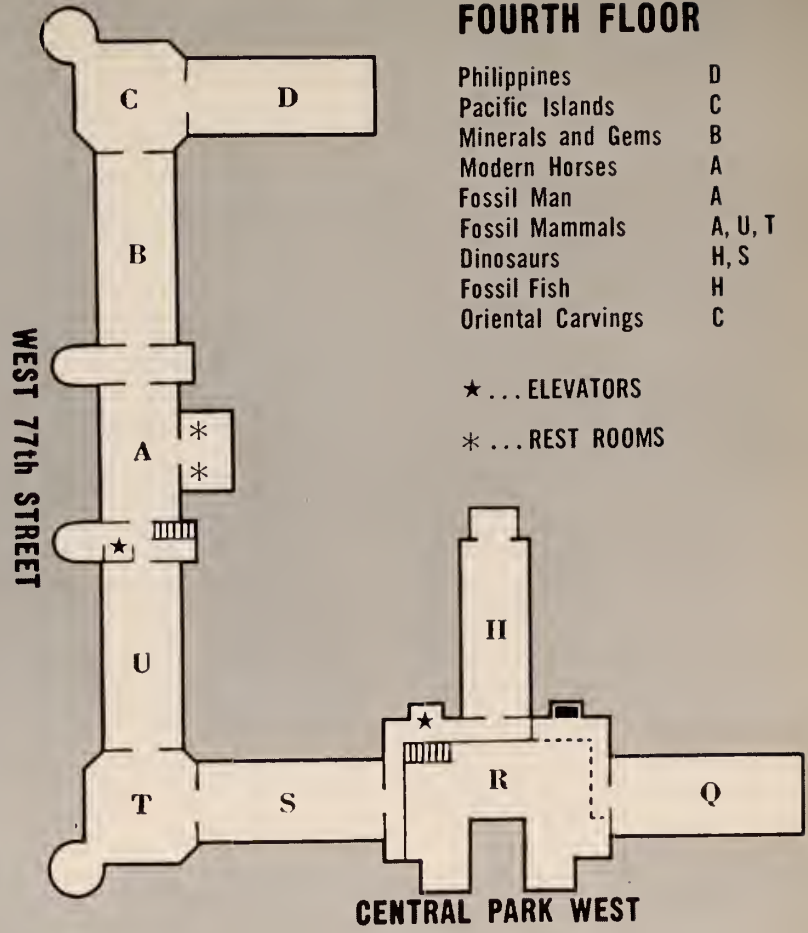


FOURTH FLOOR

Philippines	D
Pacific Islands	C
Minerals and Gems	B
Modern Horses	A
Fossil Man	A
Fossil Mammals	A, U, T
Dinosaurs	H, S
Fossil Fish	H
Oriental Carvings	C

★ . . . ELEVATORS

* . . . REST ROOMS



LOCATIONS OF EXHIBITS AND SERVICES

floors	*halls*	
2·3	H	**AFRICAN MAMMALS**
3	D	**AFRICAN NATIVES**
1	P	**AMERICAN MUSEUM-HAYDEN PLANETARIUM**
4	H	**AMPHIBIANS (FOSSIL)**
3	S	**AMPHIBIANS AND REPTILES (LIVING)**
		ANTHROPOLOGY
3	D	African Natives
4	A	Age of Man
3	C	Asiatic Natives
3	B	Biology of Man
1	J	Eskimos
1	F·B·C·D	Indians of North America
2	B	Indians of Mexico & Central America
2	D	Indians of South America
4	D	New Zealand Natives
4	D	Philippine Natives
4	C	South Sea Natives
4	D	Southeast Asia Natives
2	C	Stone Age Culture
3	C	Tibetan Exhibit
2	B·C·D	**ARCHAEOLOGY**
2	T·S	**ASIATIC MAMMALS**
3	C	**ASIATIC NATIVES**
1	J	**AUDITORIUM**
1	Q	**BIRDS (FOSSIL)**
		BIRDS (LIVING)
1	Q	Biology of Birds
2	A	Birds of the World
1	R	Local Birds
2	Q	Pacific Bird Life
3	U·T	**BUTTERFLIES**

floors	*halls*	
Base.	R	**CAFETERIA**
		For teachers and children
		(See also Snack Bar)
1	U·T	**CONSERVATION**
2	T	**CORNER GALLERY**
4	S·R·H	**DINOSAURS**
4	C	**DRUMMOND COLLECTION OF JADE**
2	E	**DUPLEX HALL**
1	U·T	**ECOLOGY**
1	E	**EDUCATION HALL**
	A·R	**ELEVATORS**
1	J	**ESKIMOS**
4	T·H	**FISHES (FOSSIL)**
1	S	**FISHES (LIVING)**
1	T	**FORESTS**
4	B	**GEMS AND MINERALS**
1	U	**GEOLOGY OF DUTCHESS COUNTY**
1	P	**HAYDEN PLANETARIUM**
2	B	**INDIANS OF MEXICO &**
		CENTRAL AMERICA
1	F·B·C·D	**INDIANS OF NORTH AMERICA**
2	D	**INDIANS OF SOUTH AMERICA**
Base.	R	**INFORMATION DESKS**
1	A	
2	R	
		INVERTEBRATES (FOSSIL).
		In preparation
1	G	**INVERTEBRATES (LIVING)**
3	U·T	**INSECTS AND SPIDERS**
1	R	
1	C	**JADE, DRUMMOND COLLECTION OF**
1	U	**LANDSCAPE HALL**
		LECTURE AND MEETING ROOMS
1	J	Auditorium
2	E	Duplex Hall
2	R	Portrait Room
1	R	Room 129
3	R	Room 319
4	R	Room 419
4	R	Room 426
5	R	Roosevelt Lecture Room
2	R	Sportsmen's Library
5	A	**LIBRARY**
1	A	**LINCOLN ELLSWORTH MEMORABILIA**
4	A·U·T	**MAMMALS (FOSSIL)**
		MAMMALS (LIVING)
2·3	H	African

floors	*halls*	
2	T·S	Asiatic
3	U	Biology of Mammals
1	G	Hall of Ocean Life
1	R	New York State
1	H	North American
3	A	Primates
		MAN
4	A	Age of
3	B	Biology of
4	A	Origin of
3	B	
2	B	**MEXICAN & CENTRAL AMERICAN ARCHAEOLOGY**
4	B	**MINERALS AND GEMS**
2	U	**MONTAÑA, MEN OF THE**
1	A	**MUSEUM SHOP**
2	E	**NATURAL SCIENCE CENTER**
4	D	**NEW ZEALAND NATIVES**
1	H	**NORTH AMERICAN MAMMALS**
1	G	**OCEAN LIFE, HALL OF**
2	Q	**PACIFIC BIRD LIFE**
4	D	**PHILIPPINE NATIVES**
1	P	**PLANETARIUM**
1	U·T	**PLANT COMMUNITIES**
1	A	**POLAR EXPLORATION**
3	A	**PRIMATES**
2·3		**PUBLIC INSTRUCTION**
Base.		**(take 1st floor Hall E elevator)**
4	T·S·R·H	**REPTILES (FOSSIL)**
3	S	**REPTILES (LIVING)**
1	R	
3·4		**SCHOOL SERVICE**
Base.		**(take 1st floor Hall E elevator)**
1	A	**SHOP**
2	A	**SNACK BAR**
		(Summer Only)
2	D	**SOUTH AMERICAN INDIANS & ARCHAEOLOGY**
4	C	**SOUTH SEA NATIVES**
4	D	**SOUTHEAST ASIA NATIVES**
3	T	**SPIDERS**
Base.	R	**SUBWAY**
2	R	**THEODORE ROOSEVELT MEMORABILIA**
1·2·3·4·5	R	**THEODORE ROOSEVELT MEMORIAL**
3	C	**TIBETAN EXHIBIT**
3	U	**WHALE MODEL (LIFE SIZE)**

THE LIBRARY

The Library is on the fifth floor of the Museum. It is devoted to works on natural science, exploration and travel and contains some 145,000 volumes which comprise not only the important periodicals of our own and foreign countries but also all representative and standard works on zoology, physical anthropology, ethnology, pre-history, archaeology, geology, and paleontology. The collection on vertebrate paleontology forms the Osborn Library of Vertebrate Paleontology, founded by the late President Henry Fairfield Osborn.

The Reading Room of the Library is open to the public from 10:00 A.M. until 4:00 P.M., except on Sundays and holidays. The Library is also closed on Saturdays from June to September. Those interested in consulting books and periodicals are welcome to do so during the available hours.

PUBLICATIONS

The publications of the American Museum fall into two groups: technical and popular.

The technical publications, comprising the *Bulletin*, *Anthropological Papers*, *Memoirs* and American Museum *Novitates*, contain information gathered by the various expeditions or derived from the study of material collected. The *Bulletin* contains the larger scientific papers, covering records of exploration and collections of the Museum. The *Anthropological Papers* are devoted to researches in the study of man, supervised by the Museum's Department of Anthropology. The *Memoirs*, quarto in size, contain monographs, many of which require large illustrations. The *Novitates* include the shorter scientific contributions, descriptions of species, etc., which demand immediate publication. The scientific publications are distributed to libraries of scientific institutions and societies throughout the world, largely on an exchange basis. Inquiries may be directed to *Editor — Scientific Publications*.

The popular publications include *Natural History* magazine, *Junior Natural History* (a children's magazine), and *Man and Nature* Publications. The purpose of all these publications is to give the public accurate and interesting information in all fields of natural science.

Man and Nature Publications deal with exhibits of particular interest and with the many natural science fields, edited for reading by the layman. More than 140 of these booklets, guides and leaflets have been issued and new ones are constantly in preparation. The *Handbooks*, fifteen of which have been issued, deal with themes related to the collections and are frequently used as textbooks.

A catalog of popular publications of The American Museum of Natural History will be sent free on request. (Address: Man and Nature Publications, The American Museum of Natural History, Central Park West at 79th Street, New York 24, N. Y.)

An Annual Report is issued yearly.

DIVISION OF PHOTOGRAPHY

The Museum maintains a Division of Photography which fulfills requests for photographs for the various departments of the Museum.

The Division of Photography houses a collection of more than 200,000 negatives illustrating the fields of natural history: anthropology, astronomy, botany, ecology, geology, mineralogy, paleontology and zoology. Contact prints or enlargements of these negatives may be purchased by the public at the cost of printing. There is also a file of several hundred Kodachrome master transparencies which is made available for reproduction on a rental basis. The department does not make color prints.

A small selection of 35 mm. slide sets in color are for sale. Both 35 mm. and 3¼ x 4″ slides can be made from any of the black and white negatives in the collection.

Photographs obtained from the Division of Photography may be reproduced, but permission to do so must first be given by the department.

The Division of Photography offers upon request the service of making new photographs of natural history and related subjects. Photographic copies from books, existing photographs, etc. may also be had.

Since the collection of photographs is quite large, and is constantly growing, it is impossible to maintain an up-to-date, descriptive catalog of pictures. Special lists will be made up on request whenever possible. There is, however, a price list which describes in greater detail than is possible here, the work of the Division of Photography. In it are quoted the prices for black and white contact prints, enlargements, slides, color slides, new photographs, copy work and reproduction fees.

The Division of Photography is open to the public Monday through Friday from 10 A.M. to 5 P.M. Persons interested in securing photographic material may either come in person to consult the files or they may write or telephone their requests. The department is in the School Service Building of the Museum, on the fourth floor. Letters should be addressed to The Division of Photography, American Museum of Natural History, Central Park West at 79th Street, New York 24, N. Y. The telephone number is TRafalgar 3-1300, Extension 447.

THE HISTORY AND WORK OF THE MUSEUM

The American Museum of Natural History was founded and incorporated in 1869 for the purpose of establishing a Museum and Library of Natural History; of encouraging and developing the study of Natural Science; of advancing the general knowledge of kindred subjects and of furnishing popular instruction. For eight years its home was in the Arsenal in Central Park.

The cornerstone of the present building in Manhattan Square was laid in 1874 by President Ulysses S. Grant. In 1877, the first section (South Central Wing) was completed and on December 22nd, 1877, it was formally

The Museum's First Unit, completed in 1877

opened by President Rutherford B. Hayes.

The educational work with the schools was begun in 1880 by Professor Albert Bickmore.

The Museum building is one of the largest municipal structures in the City of New York. The South Facade is 710 feet in length and the present East Facade, on Central Park West, is 600 feet. When completed, the building is designed to occupy all of Theodore Roosevelt Park.

The building is largely erected and maintained by the City, through the Department of Parks. The Roosevelt Memorial section was the gift to the City by the State of New York as its monument to Theodore Roosevelt. The Whitney Wing was built jointly by the late Harry Payne Whitney and the City of New York. The American Museum-Hayden Planetarium was financed by funds loaned by the Reconstruction Finance Corporation of the Federal government. The annual City appropriation, known as the Maintenance Fund, is devoted to the care and upkeep of the building and the safeguarding of the collections.

The Museum is under the control of a self-perpetuating Board of Trustees, which gives its services.

The scientific and educational work is carried on by twelve departments, each headed by a Chairman or Curator, under the leadership of the Director.

The funds through which specimens are purchased, exhibits made, explorations carried on and scientific investigations conducted are contributed by the Trustees, members and other friends. The scientific and popular publications of the Museum and the enlargement of the Library are also made possible through these contributions.

For the benefit of the public, the halls of the Museum are given over to the large series of exhibits which are partially described in this guide book. These are supplemented by lectures and publications of a popular nature.

Special motion picture showings are given on Wednesday and Saturday afternoons except from June through September. An important course of evening lectures is given every Spring and Fall for the members, also Saturday morning courses of special lectures for children of members. All lectures are illustrated by motion pictures or Kodachrome slides, many of which have been taken on Museum expeditions. Two auditoriums within the Museum are in use for public showings — the Main Auditorium on the first floor and the Roosevelt Lecture Room on the fifth floor of the Roosevelt Memorial.

OFFICES AND LABORATORIES

The fifth floor of the Museum houses administrative offices, work rooms and the laboratories of most of the Scientific Departments. On this floor are the work rooms of the Department of Vertebrate Paleontology, where the skeletons of fossil animals are prepared and mounted and the beautiful models of invertebrates are made. These, like the other laboratories, are, of necessity, not open to the public.

On the sixth floor of the African section are the well-equipped laboratories devoted to experimental biological research and to physiology and life histories based on the study of living animals.

Most of the scientific study collections are on the fifth floor. These are for the benefit of investigators and to preserve the evidences and records of our vanishing animal life and the lives and customs of primitive peoples.

The vast majority of the Museum's natural science specimens is in study collections to protect them from damage and for ready use by scientific investigators. A careful selection is made of objects of greatest educational value and these form the basis of the Museum displays in its exhibition halls.

Archbold Biological Station

The Archbold Biological Station, at Lake Placid, Florida, was established in 1941 by Richard Archbold, its Director, to provide scientists and students with the facilities for biological research in subjects best studied in southern Florida. The station is open throughout the year to all qualified investigators whose applications must be approved by the Advisory Board.

The Station is admirably equipped and situated for the study of the varied environment of the region and affords a rich and diversified flora and fauna, including peculiar forms of limited distribution. Probably no other area in southern Florida presents such a variety of interest for biological research.

The Lerner Marine Laboratory

The Lerner Marine Laboratory was established in 1947 by Mr. Michael Lerner to further field studies in marine biology through the Department of Fishes and Aquatic Biology. Located on the island of Bimini, almost sixty miles due east of Miami, Florida, the laboratory occupies about two

and one-third acres on which are the laboratory building, a residence for workers, a storehouse and a power house.

The laboratory building contains four laboratories, a study, two combined aquarium and lab rooms, an animal room, a refrigerator room, a constant temperature room and a photographic dark room. Glass-bottomed boats, diving equipment, seines and nets and other facilities are available for researchers. A limited number of applications are accepted yearly by the Museum for workers who wish to use the laboratory facilities.

Genetics Laboratory

Another laboratory within the Museum is engaging in experiments on the hereditary patterns of tropical fish, the results of which are being used to determine the influence of heredity in cancer.

Fish-raising enthusiasts, familiar with the problems of cross-breeding Mexican platyfish and common swordtails, know that the spotted hybrids often develop tumors. Experiments have been going on for over twenty-five years to find the source of these tumors.

When two pure strains of the platy were bred — one with black pigmented spots and the other unspotted — the first-generation platyfish would necessarily be spotted. The spotted pattern is a dominant trait and the unspotted pattern recessive. The black spots are inherited in accordance with Mendel's law of heredity. A cross-bred hybrid from an unspotted platy of the second generation and an unspotted swordtail is unspotted and normal.

When a spotted platy is crossed with an unspotted swordtail, the hybrids have tumors identified as black cancer or melanoma. The findings show that the swordtails carry dominant modifying genes which interact with the black spot-carrying genes of the platy, so that the black cells of the hybrid develop cancer.

The next experiments were made with one species, the platy, and proved that black cancer in fish is hereditary. The facts derived from such experiments are being used to determine a possible basis for control of those types of cancer that are inherited in man.

The laboratory for this research is housed in the American Museum and is directed by the geneticist of the New York Zoological Society and supported by a grant from the National Cancer Institute of the U. S. Public Health Service.

The Southwestern Research Station

The Southwestern Research Station, at Portal, Arizona, was established in 1955 through the initial interest and support of David Rockefeller and the subsequent cooperation of other individuals and organizations. Its purpose is to make available research facilities for scientists and students in all branches of science who have projects that can be investigated through the utilization of the faunal, floral, and geological features of the area.

The facilities of the Station include residential developments, camping

The Theodore Roosevelt Memorial Hall

facilities, a Laboratory and complete equipment, library, utilities, and other conveniences. Interested scientists and students may write to the Station Director for further information.

WORKSHOPS

A completely equipped series of workshops in the Museum's basement provide the various types of cases used, build and repair the Museum's furniture, and make installations for the exhibition halls. A print shop prints museum publications, business forms, and labels.

ENTERING THE MUSEUM

Fifty-eight halls and exhibition areas of the Museum are now open. The visitor may begin his trip through this immense treasure house of natural science by means of any of five entrances: the first and second floor entrances of the Roosevelt Memorial; the American Museum-Hayden Planetarium; the South, or 77th Street Entrance, and the Eighth Avenue Subway Entrance.

The Theodore Roosevelt Memorial

The Theodore Roosevelt Memorial, designed by John Russell Pope, forms the main entrance to the Museum on Central Park West. Its graceful architecture follows a stately classic design.

The façade of the Memorial is set off by four Ionic columns 54 feet high, representing Boone, Audubon, Clark and Lewis, pioneers in the early exploration of our country. A massive equestrian bronze of Theodore Roosevelt by J. E. Fraser stands before the entrance arch. On either side of him stand an American Indian and an African native.

Passing through the central archway, the visitor stands in the great Memorial Hall. Above the marble mosaic floor, walls of cream-colored marble and limestone rise to an elaborate Corinthian cornice over-arched by an octagonal coffered barrel-vault 100 feet above the floor. The central part of each wall is recessed and divided into three parts by two Roman Corinthian columns 48 feet high supporting the entablature. Three of these recesses are adorned with great mural paintings symbolic of the varied career of Theodore Roosevelt. On the wall, quotations from his writings are given in bronze letters. Wall cases in the Roosevelt Memorial contain memorabilia of Theodore Roosevelt's life.

The Theodore Roosevelt Memorial was erected by the people of the State of New York in memory of the man whose name it bears.

South Entrance Archway

Under the arch on 77th Street, before entering the Museum doorway, may be seen the Bench Mark established by the United States Geological Survey in 1911, on which are inscribed the latitude and longitude, 40°46′47.17″ N., 73°58′41″ W. and height above sea level, 86 feet.

On the right is a GLACIAL POT HOLE from Russell, St. Lawrence County, N. Y., formed by an eddy in a stream beneath the melting ice of the glacier that once covered northern New York State. Pebbles, whirling around the eddy, cut and ground this hole which is two feet across and four feet deep.

GLACIAL GROOVES. On the left is a large slab of fossil-bearing limestone from Kelly Island in Lake Erie, near Sandusky, whose surface has been smoothed, grooved, and scratched by the stones and sand in the bottom of the vast moving ice sheet that covered northeastern North America during the Glacial Epoch.

On either side of the archway are the two largest beryl crystals ever quarried. They were cut in Albany, Maine. These six-sided crystals show the typical aquamarine color in their clearest portions.

Memorial Hall

Memorial Hall is entered through the lobby from the South Entrance. In this hall are placed temporary exhibits of current interest, many of these exhibits representing research in various departments of the Museum and recent results of exploration by Museum expeditions.

EXPLORATION AND GEOGRAPHY

Exhibits showing equipment of polar expeditions made in cooperation

with the Museum are in the corridor leading to the 77th Street elevators.

Here are sledges with which PEARY (1909) and AMUNDSEN (1911) reached the North and South Poles respectively: also memorabilia of the AMUNDSEN-ELLSWORTH expeditions of 1925 and 1926 and Ellsworth's four Antarctic expeditions. Maps of the Polar Regions show the routes of various explorers and the polar air flights.

MUSEUM HIGH SPOTS

Rare and Extinct Birds—including reconstruction of the Dodo and a skeleton of the Mammoth Moa—in the Leonard C. Sanford Hall of the Biology of Birds, 1st floor.

Moa—reconstruction of this giant extinct bird, New Zealand Moa group—Whitney Memorial Hall of South Pacific Birds, 2nd floor.

Alaska Brown Bear—largest bear in the world—Hall of North American Mammals, 1st floor.

"An October Afternoon Near Stissing Mountain"—strikingly realistic habitat group of the Pine Plains area of Dutchess County, N. Y.—Felix M. Warburg Memorial Hall of Ecology, 1st floor.

Meteorites—one of the world's largest meteorites: the Ahnighito—34 tons—brought from Greenland in 1897 by Admiral Peary—American Museum-Hayden Planetarium, 1st floor.

Drop of Water—Magnified a million times—depicted in a blown-glass model—Hall of Living Invertebrates—Gallery of the Hall of Ocean Life, 1st floor.

Men of the Montana—the story of life in a Peruvian Rain Forest—authentic, recorded sound effects—Special Exhibition Hall, 2nd floor.

Oil Derrick Model—Oil Geology Hall, 2nd floor.

Little Diomede and Big Diomede—islands in Bering Strait—International Boundary Line passes between them. Big Diomede is Russian, Little Diomede American—Whitney Memorial Hall of South Sea Birds, 2nd floor.

African Elephant Herd—Akeley African Hall, 2nd floor.

Stone Head of Olmec Style—Mexican and Central American Hall, 2nd floor.

The "Copper Man" Mummy and Shrunken Heads—South American Indian Hall, 2nd floor.

Moths and Butterflies—from all parts of the world—Insect Hall, 3rd floor.

Dragon Lizards of Komodo—the world's largest living lizards—Reptile Hall, 3rd floor.

Ivory Collection—African Ethnology Hall, 3rd floor.

Tyrannosaurus Rex—king of dinosaurs—Tyrannosaur Hall, 4th floor.

Brontosaurus—great plant-eating dinosaur—dinosaur footprints—Brontosaur Hall, 4th floor.

Dinosaur Eggs—80 Million Years Old—from the Gobi Desert—Tyrannosaur Hall, 4th floor.

Topaz Crystal—600 Pounds—largest in the world—Morgan Hall of Minerals and Gems, 4th floor.

Wild Dog Group—a hunting pack of African wild dogs looking across the plains—Akeley African Hall gallery, 3rd floor.

public instruction

public instruction

The week-day visitor to the American Museum will see groups of eager children standing with an instructor before various exhibits. Some of these groups may be classes with their own teachers, but most of them are a part of the Department of Public Instruction's "World We Live In" program, designed for children of elementary school grades. Subjects or "themes" have been cooperatively planned with the school authorities.

This program, scheduled for each school day from 10:00 A.M. to 2:00 P.M., gives the children a complete day in the Museum, with subjects and teaching aimed at helping them to a more meaningful understanding of the world in which they live. This is done with lessons in the halls, question and answer periods, motion pictures, physical demonstrations of principles or facts to be stressed, and the actual handling of objects of natural science interest.

Special attention is given to classes or groups of children with visual and other physical handicaps. For full information, write or phone the Registrar, Department of Public Instruction, The American Museum of Natural History, New York 24, N. Y. Telephone, TRafalgar 3-1300, extension 255.

ADULT COURSES

Each semester the Department of Public Instruction offers a varied group of courses both in the natural and social science fields. These courses are planned for the layman and offer kinds of experiences not obtainable elsewhere. A catalog may be obtained by writing the Registrar.

NATURAL SCIENCE FOR THE LAYMAN

This course, given each semester, is a series of field trips to nearby localities. It gives adults a chance to become acquainted with plant and animal life and the important Man-Nature relationships. Service charge for the course is $1.00 per trip for non-members and $.75 for Annual Members and other higher classes of the Museum. For complete information, write or phone Miss Farida A. Wiley, Department of Public Instruction.

CAMP COUNSELLORS AND YOUTH LEADERS COURSE

This course is given each spring to increase the efficiency of group work in the natural science field in summer camps and youth centers. Service charge is $15 for non-members and $10 for Annual Members of the Museum. For further details, write or phone the Registrar.

NATURAL SCIENCE CENTER

The Peter Van Gerbig Natural Science Center for Young People is an exhibit and service center that introduces youthful New Yorkers to the

Many Thousands of School Children *come to the Museum in the course of a year. One of the most important aspects of their instruction by a staff of specially trained teachers is the actual handling of objects and materials.*
Left: A school boy wearing an Oriental hat learns how to use chopsticks. To the right, a group of children study a large sea shell under the direction of one of the Museum staff.

wildlife and geology of the metropolitan area. The informal exhibits include some living plants and animals, study collections of natural history specimens, and seasonal exhibits that suggest "things-to-do."

The Center is open to the public on week-day afternoons from 2:00 to 4:30 (closed Fridays); on Saturday from 10:00 A.M. to 4:30 and on Sunday from 1:00 to 4:30. Classes and groups wishing to visit the Center must arrange with the Registrar in advance.

MUSEUM COURSES FOR TEACHERS

A series of courses is offered to teachers and interested laymen each fall and spring on the various aspects of the social and natural sciences. These courses are accredited at City College, and also offered for in-service credit to New York City teachers. For information write or phone Registrar, Department of Public Instruction.

NURSE EDUCATION PROGRAM

A Nurse Education Program, designed to enrich nursing school curricula in the natural and social sciences, is offered to nurses in training at The American Museum of Natural History. The specific material included in each program is worked out in conjunction with the nursing schools attending, to meet the needs of each group. For information write or phone Supervisor of Adult Programs, Department of Public Instruction.

FREE MOTION PICTURE PROGRAMS

Museum visitors are invited to attend free motion picture programs on natural science subjects. The Wednesday series runs throughout the year, and begins at 3:30 P.M. The Saturday series is from October to May, and begins at 2:00 P.M.

DIVISION OF CIRCULATING EXHIBITS

This collection of educational exhibits and specimens in the field of natural science is carried to schools for classroom use. Materials are selected to meet subject requirements in science, social studies, and related subjects. A fleet of Museum trucks services the schools on a regular schedule. For full information, write or phone the Supervisor of Circulating Exhibits.

ADVISORY SERVICES

On request, the Department provides advisory services on the educational use of museum resources.

From a one-man lecture service, begun in 1884 by Albert S. Bickmore, the Department has expanded until over 10,000,000 persons are reached each year by its programs and services. Many of these services are carefully checked with Boards of Education and other educational agencies so that offerings will be in keeping with their needs.

making the exhibition hall

making the exhibition hall

The construction of the beautiful exhibits in The American Museum of Natural History is, in itself, as interesting as the viewing of them by the more than two million persons who visit the Museum annually. At the request of many visitors, we have included in the General Guide just what goes on before an exhibition hall is open to the public.

We will take the Felix M. Warburg Memorial Hall of Ecology as an example. This hall depicts an area from early ages to the present, with all the interrelationships of environment, plant, animal and human life. Its method of presentation is a radical departure from the hitherto accepted method of museum exhibition.

First, the basic idea of the Hall is outlined in synopsis form. It is the complete story which the Hall will convey that the scientists think ought to be included in it, together with the emphasis they want made in the displays.

A committee of the Director, Board members, scientists and educational advisers studies the synopsis and passes on it. A lively discussion determines what can be added to make the exhibition as valuable as possible. The committee also decides on the location of the new Hall.

After the idea and the location are approved, the synopsis is analyzed

from a display angle and the Manager of Exhibition and Construction, together with his designers, draws up plans for the exhibits which are then submitted to the Director and his committee for approval. When the necessary funds are found, the work begins.

Metal workers, masons, electricians, carpenters and painters build the structures that will house the habitat groups, dioramas, models and other kinds of display. Meantime, the Department of Exhibition is working on the exhibits themselves. This work includes research into new preservation and display techniques, such as plastic embedding and infiltration. From these experiments much knowledge is gained for future projects as well as for the use of scientific departments.

As you enter the Warburg Memorial Hall from the 77th Street Foyer, you will note a large, eye-catching exhibit entitled "An October Afternoon Near Stissing Mountain." It shows the brilliant autumn coloring typical of this region, together with some animals found there. As an example of the building of the larger group, let us see how it was made.

Using sketches and Kodachromes made at the scene, the artist roughs out his picture on the curved background. Because there are no corners, the visitor is given a feeling of depth, perspective and reality that is not possible with a flat painted surface. After the sketch is rendered in charcoal, the artist fixes it with a shellac spray. Then, with fine oil pigments, he paints in the background of the group. He may employ as many as thirteen shades of blue in painting a sky from the horizon to the zenith.

One of the artist's difficult jobs is to make it appear as though the foreground objects continue into the vertical background. You will notice that he places clumps of red-leaved sumac against the background, then paints more sumac as though it grew beyond the real plants. When his careful color-matching and artistry are finished, the visitor has trouble telling where the foreground ends and the painted background begins.

If you look at the foreground, you will see that it is not flat, but rolling, as is the natural conformation of the land at this particular site near Stissing Mountain. This foreground, or terrain, is made by first determining the character of the actual ground, then cutting wooden forms or contours to match it. These forms are then covered with heavy wire netting, then burlap and plaster-of-paris, strong enough to hold up the weight of the men who are working on the group. This foreground is the foundation for the earth, plant and animal life in the exhibit.

While construction work and background painting are going on, the Department of Exhibition has been making accessories, exhibits, models and special effects for the Hall. Accessories include artificial leaves and flowers, trees, bushes, manufactured rocks, fruits, berries, preserved plants and mosses. At the same time, preparators are tanning skins, getting them ready to be mounted.

Some plants can be used as they grow in nature. Members of the pine

Museum Tanner, *scraping down a hide with a special circular knife to soften it before it is mounted on the hollow manikin.*

family, mosses, and grasses are soaked in a solution of formaldehyde and glycerine. The glycerine prevents the plant from drying out and keeps it pliable. The formaldehyde preserves the material, but because it also tends to fade natural colors, the technicians must bring back the original hue by spraying with an air brush and lacquer of the right shade.

Clumps of grass are mounted on plaster-of-paris bases and sprayed with lacquer if the natural color is desired. In the group you may see some of this grass, each bunch standing close to the next, with earth patted down between the bases.

Most leaves are made by tracing the leaf pattern on a thick pad of crepe paper, although a newer technique is to form them out of plastic sheets in a vacuum press. The pattern is cut out with a fine-toothed band saw. Hundreds of leaves are turned out at one time by this method. An order may call for as many as ten thousand leaves. Each leaf must be handled separately after being cut out, as veins must be drawn or embossed, insect holes simulated and color applied to match the original. Even the midribs, of

iron wire, are carefully tapered by dipping bundles of wire into nitric acid. The dripping-down of the acid thins the wires toward their ends.

Flowers may be molded from thin sheets of cellulose acetate, a non-inflammable plastic material. The acetate sheets are "limped" in a solution of acetone, placed in the mold where they take form, are removed, trimmed and delicately painted by hand. Even the tiniest pistils and stamens are painstakingly made so that the flowers will be as botanically accurate as possible.

There are no artificial rocks in "An October Afternoon Near Stissing Mountain." Artificial rocks are used when the real ones would be too heavy. Samples of real rocks and photographs of them help the technician to copy nature. He makes his rocks from wire netting, burlap, plaster-of-paris, papier mache and coloring materials. Should he be required to produce a "wet" rock, he runs shellac or varnish down the side and lets it dry.

In the "October Afternoon" group, you can see a red fox looking at a bluejay sitting in a canoe birch. The fox and the bird, as well as other small animals shown in the Hall, are mounted by putting their skins on artificial bodies made of wrapped excelsior.

There are no animals in the Warburg Memorial Hall that are mounted on hollow manikins. But this is such an interesting process that we have included it in our description. First, it must be understood that the Museum animals are not stuffed. The larger ones are mounted on manikins, similar to those human forms found in the show windows of New York shops.

The manikin is begun by putting the animal's bones together on a wood and wire framework in the natural position desired, then patting sculptor's clay over the whole assembly. A statue is modelled by the sculptor, who is an

The Tanned Skin *is carefully fitted over the manikin and sewed together so exactly that it is hard to find the stitches.*

expert animal anatomist. Making the statue is a long task and when the artist goes home at night or over the weekend, he wraps his work in woolen blankets, soaked with water. This keeps the clay fresh and impressionable. The statue is made as though the animal had just lost its skin — that is, the muscles, tendons, prominent veins and ribs are shaped in the clay so that they will show under the tanned skin when it is fitted to the manikin.

When the statue is finished and the skin has been tried on for size, the sculptor makes a plaster cast of it. When the cast is taken off, it is lined with overlapping strips of burlap. This rough fabric is coated with liquid plaster-of-paris, about as heavy as cream. When the plaster hardens in the burlap lining, the "shell" is removed, braced, put together, coated with a preservative and is now a manikin, waiting for the animal's skin.

Fitting the skin to the manikin is a delicate process. An adhesive is placed on the under side of the skin as it goes on the manikin. The skin is sewed up with needle and thread. The stitches do not show because they are on the under side.

To make sure that all the muscles, veins, ribs and hollows are prominent, the technician drives hundreds of small nails or pins through the skin into the manikin, to keep the skin tight around key points. When the adhesive is "set" in two or three days, the nails or pins are taken out. The animal now seems to have rippling muscles, his ribs show as they should, and even veins in his muzzle are as plain as they would be in a living specimen.

Good examples of such large mounts may be found in the Giant Eland Group or the Giant Sable Group in the Akeley African Hall on the second floor.

Now our background is painted, the terrain is covered with plants, the animals have been placed and "An October Afternoon Near Stissing Mountain" is complete. But the Department of Exhibition has been busy making many more displays for the Hall, other than the accessories for "An October Afternoon."

It has made farm buildings, farm machinery, small dioramas and cut-outs, mirrorscopes through which the visitor sees a remarkably realistic presentation of landscapes in many aspects, soil profiles, scientific models of root systems, apple blossoms, the hind leg of a bee with its pollen basket, the life history of the codling moth that attacks apples, studies of photosynthesis and respiration for the "Cycle of Nutrition and Decay" and many other displays and models requiring scientific accuracy and infinite attention to detail and exact coloration.

The groups, displays and models have been checked by the Scientific Departments concerned. Geology advised how the mountains looked during various time periods, as shown in the displays "Geological History and Structure." Advice was given on "The Water Cycle," "Soils and Soil Conservation," and "Life in the Soil."

Paleontology checked the accuracy of dioramas and objects that show

James Perry Wilson, *Museum artist, painting the background for the Jeffrey Pine Forest Group,*

the prehistoric plants and animals that lived in this place many thousands of years ago.

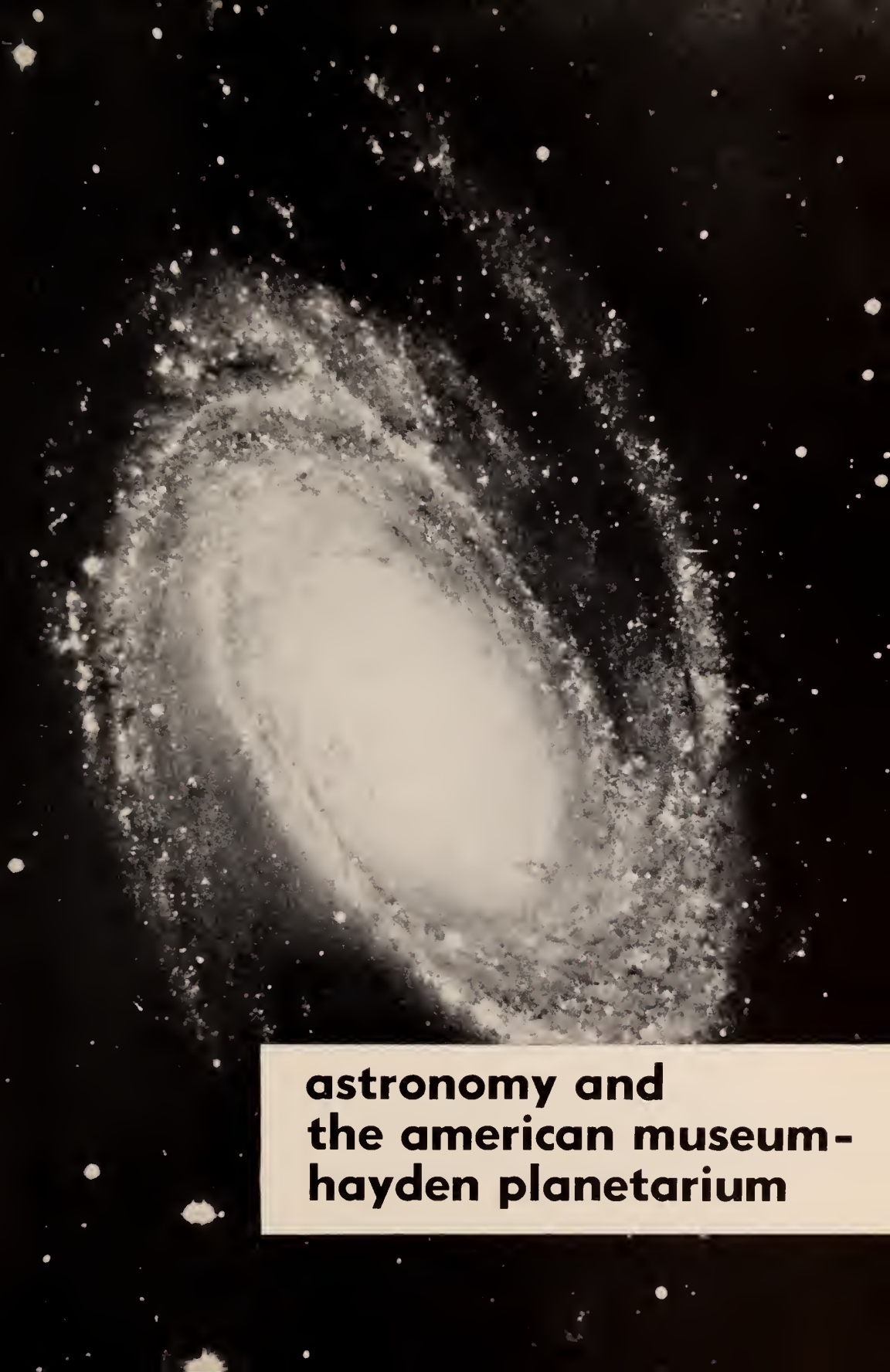
The Bird and Mammal Departments saw to it that the bluejay, the fox, the chipmunks, muskrat and other animals in the Hall were carefully installed in authentic positions and relationships.

The Department of Insects and Spiders supervised the placement of dragonflies, butterflies and beetles, to be found in "An October Afternoon," "From Field to Lake," and "Cycle of Nutrition and Decay."

The Department of Amphibians and Reptiles and the Department of Fishes worked with the technicians and the preparators to insure the accuracy of the use of turtles, trout, catfish, perch and pickerel shown in "From Field to Lake."

The Department of Anthropology made its recommendations as to the best way to show man's part in this environmental exhibition. It checked on house and farm styles, tools, machinery, and agricultural methods of the various times depicted. All Scientific Departments concerned in the Hall helped in the writing of labels and other informative material.

At last the Felix M. Warburg Memorial Hall is completed. Into it has gone much of the Museum's time, money, talent and effort. The Director, Board members, advisory committees, the Scientific Staff, architects, exhibition personnel, artists, preparators, tanners, technicians, metal workers, masons, carpenters, painters, bookkeepers, public relations people, photographers, attendants — all have given of the best that is in them to make an exhibition hall of lasting beauty, scientific accuracy and educational importance.



astronomy and the american museum-hayden planetarium

astronomy and the american museum-hayden planetarium

The American Museum-Hayden Planetarium adjoining the Roosevelt Memorial, with its main entrance on 81st Street and Central Park West, constitutes the Museum's Department of Astronomy. Since the complete story of natural science begins with the story of the universe, it is fitting that the Planetarium's description begin the General Guide.

The establishment of the Planetarium in 1935 marked the culmination of a ten-year effort to secure a planetarium projector for the American Museum of Natural History. The Trustees of the Museum had, in 1933, formed a separate corporation under the Reconstruction Finance Corporation to build and equip a planetarium. Mr. Charles Hayden, after whom the building is named, donated the Copernican model solar system on the first floor and the planetarium projector. This complicated piece of precision equipment was developed by the firm of Carl Zeiss at Jena, Germany, to present the fascinating and everchanging drama of the skies.

The great Zeiss projector is the very heart of the Planetarium. It is installed in a hemispherical dome 75 feet in diameter and 48 feet from the floor to the highest point in its circumference. The moving portion of the instrument itself weighs 2 tons and is 12 feet long. At either end of it are large star globes, each of which contains sixteen separate lens systems. In

these lens systems are incorporated copper foil plates with holes of various sizes for stars of different magnitudes, so that a central light source causes the star images to appear on the dome with their relative intensity. These images fit together in such a way as to reproduce the constellations exactly as seen in the real sky under ideal weather conditions and show all the fixed stars visible to the unaided eye from any part of the earth. Each of the thirty-two star field projectors is provided with a device which acts like an eye-lid and automatically eclipses the star images when they are below the horizon. Individual projectors for the sun, moon and the five naked-eye planets are mounted in the latticed cylinder that supports these globes.

The instrument also contains special projectors for showing the Milky Way, a typical comet, important variable stars and the reference circles used by astronomers in describing the positions and motions of the celestial bodies. Above each of the two large star globes are smaller globes which throw upon the dome the traditional constellation figures used by early astronomers.

The main projector turns independently on any one of three axes. First, it may turn on an axis parallel with the polar axis of the earth. This reproduces the apparent westward motion of the heavenly bodies due to the earth's rotation.

Second, it may rotate on an axis perpendicular to the plane of the earth's orbit about the sun. The effect of this is to swing the north pole of the heavens in a vast circle that is completed every 25,800 years. This motion, known to astronomers as "precession," introduces a slow change over a long period of time in the sky picture. By its use, the Planetarium lecturer can set the instrument back some 5,000 years to 3,000 B.C. when Thuban, a dim star in the constellation of the Dragon, was our North Star. By running the instrument ahead some 12,000 years, we can see Vega, fourth brightest star, marking the north pole of the heavens while the Southern Cross is visible from the latitude of New York.

Third, the projector may also be turned about an east-west axis to show the change that occurs in the sky picture with a change of latitude on the earth. Thus, it may show the sky as seen from the North Pole, or, by traveling south, one may see the Magellanic Clouds or the Southern Cross. Use of this motion enables the lecturer to carry his audience around the world in about five minutes.

The motions of the sun, moon and planets are accomplished by a complex arrangement of motors and gears so that they may be set in any position relative to the stars for any date and hour for many centuries backward or forward in time. This so-called annual motion also sets the moon at its proper position and phase for any given time.

The dome itself, upon which the stars are seen, is made of perforated sheet steel, painted white on the inside, enclosed in an outer shell of concrete and copper. The lower edge of this steel dome is cut away in a

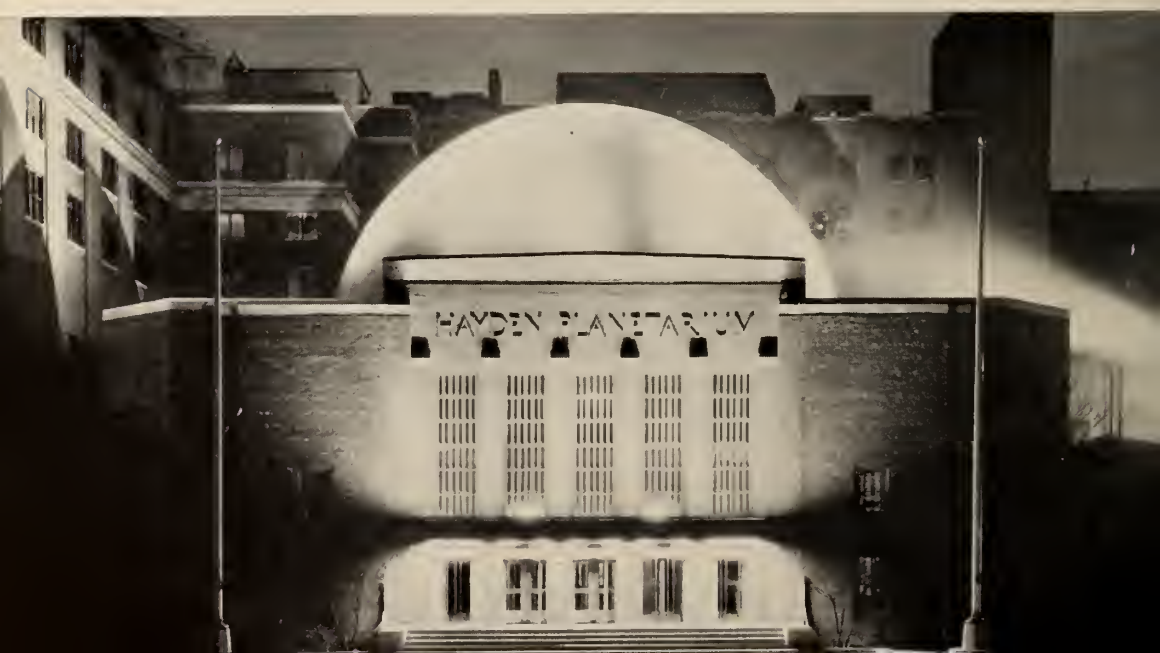
design that pictures very accurately the New York City skyline as seen from Central Park. Under this great dome, the lecturer, with a complicated series of buttons, dials and switches to control and with over two thousand possible combinations at his command, is virtually master of the universe.

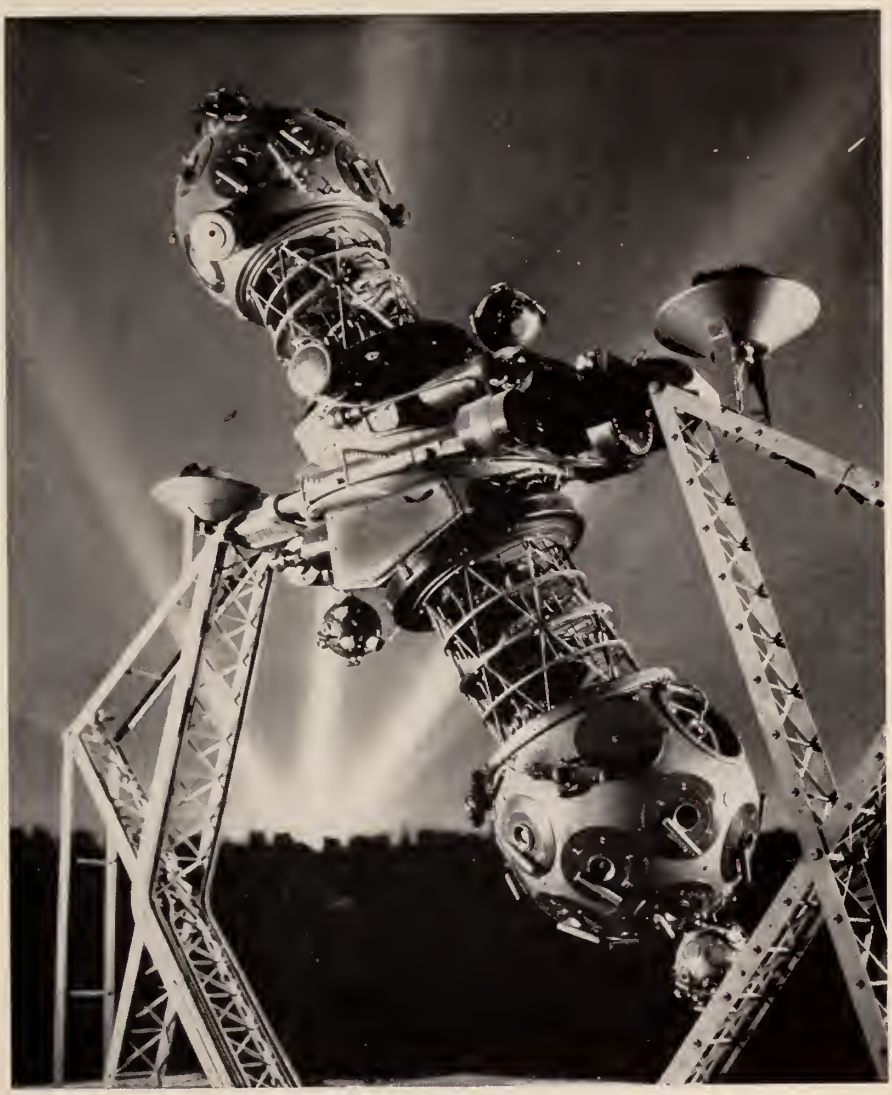
A mere physical description of this amazingly complex and versatile instrument does not do justice to the breath-taking effect of a Planetarium presentation. To the visitor, it is as though the boundaries of the great domed room have disappeared, revealing the very depth and feeling of infinite distances in a star-studded sky as the unclouded night slowly falls.

The Planetarium projector alone does not bring the entire sky story to the audience. Supplementary effects and techniques are constantly developed to widen the range of action. Horizon scenes, an observatory interior, a rainbow, a swirling blizzard, eclipses, the radiance of the northern lights, thunderstorms and a host of accessory effects are created. When these are combined with controlled lighting, music and special sound effects, the result is as thrilling as the most dramatic of theatre productions.

Over half a million persons visit the Planetarium each year to see such performances as "Trip to the Moon," "From Galileo to Palomar," "Exploring the Milky Way," "Color in the Sky," "Messengers from Space," and the Christmas show, "The Star of Bethlehem." There is a change of program about eight times a year and regular presentations are given at scheduled times during the afternoons and evenings of every day in the year.

The Hall of the Sun is on the first floor. Suspended from the ceiling of this circular room is a 48-foot model of the solar system in which the naked-eye planets are shown moving about the sun at their proper relative speeds. On the walls of this room are the constellations of the Zodiac whose stars, in luminous paint, seem to scintillate against a deep blue background as of the night sky. The floor of the Hall of the Sun is enriched by a repro-





The Zeiss Projector of the Planetarium

duction in terrazzo of the Aztec Calendar Stone. It was made by Victor Foscato and symbolizes the sun which was to the Aztecs the most important of the heavenly bodies. The Planetarium demonstration begins in this room with a preliminary lecture which prepares the audience for the "sky show" in the dome on the second floor.

A fine collection of astronomical paintings decorates the Planetarium walls. On the first floor, opposite the main entrance, the visitor sees a large mural painting and two panels by Charles R. Knight, depicting some of the sky-legends of the American Indian. On the walls of the wide stairways hang paintings of eclipses and the aurora, with two canvases over the north entrance to the dome showing telescopic views of Mars.

Over the dome's south entrance are three astronomical paintings by the late Howard Russell Butler of Princeton. They are perhaps his most striking canvases and are lighted by a method devised by Mr. Butler which

Main Entrance to
American Museum-Hayden Planetarium

makes them appear to be realistic transparencies rather than opaque paintings. The first of these represents the solar eclipse of June 8, 1918, observed at Baker, Oregon; the second, that of September 10, 1923, at Lompoc, California; and the third, that of January 24, 1925, at Middletown, Connecticut.

The Planetarium houses two of the world's finest meteorites: the Ahnighito, 34 tons, and the Willamette, 15½ tons. In addition to these, the Woman, a small meteorite of 3 tons, stands before the Book Corner.

In the first floor corridor is an outstanding loan collection of sundials, compasses and astronomical instruments, ranging from ancient Chinese, through the elaborate metal instruments made in the middle centuries in France and Germany, down to the very accurate compasses of modern navigation.

Set into the walls of the corridors of both floors are large transparencies on glass of astronomical photographs from various observatories throughout the world. They include pictures of the sun and moon, many of the planets, star-fields and star-clusters, gaseous, planetary and spiral nebulae, comets, meteors and meteor craters as well as some of the most famous astronomical instruments. Since many of these photographs are time-exposures, they reveal the celestial objects far better than they could be seen visually through the largest telescopes and show much detail that would otherwise escape the eye.

Many of the exhibits in wall cases on the second floor are changed from time to time and have included views of the world's Planetaria, scientifically correct drawings in color of stars and other objects, possible activities of pioneer lunar explorers and kindred interesting and dramatic scenes.

A striking exhibit of astronomical phenomena, painted in luminescent color activated by "black-light," is in the corridor on the first floor. Here are fourteen murals, covering an area of 4,000 square feet, showing in vivid detail such subjects as sun-spot activity, the Aurora Borealis, solar prominences, eclipses of the sun and moon, galactic and spiral nebulae and our neighboring worlds, the other planets.

Left: A full-size Viking rocket, *parts of which have been propelled to an altitude of 158 miles above the surface of the earth. The children are examining the interior of the rocket, cut away to show the various mechanisms.*

Right: "Black-light" *striking luminescent paints of various colors causes them to glow in the dark. Museum artists have created startling and beautiful murals showing in vivid detail such subjects as sunspot activity and the planets.*

Typical of the three-dimensional effect created by this recently developed technique is the mural of the Aurora Borealis. A curtain-type aurora is seen from the Arctic Circle where such displays reach their greatest brilliance and color. Through moving sources of "black-light," the aurora in the mural seems to shimmer, as do the actual Northern Lights.

Many of the wall cases are given over to dioramas which show, in three-dimensional effect, various aspects of astronomy and meteorology. The astronomical exhibits are varied from time to time and have included such diverse subjects as the 100-inch Hooker Reflector at Mt. Wilson; the 18th century observatory at Jaipur. India; the ancient observatory at Peking, China, and Sir Isaac Newton's discovery that sunlight is composed of the colors of the spectrum.

Of constant interest to visitors are the semi-permanent exhibits on the second floor of the Planetarium. "Your Weight on Other Worlds" is a set of five Toledo scales calibrated to show the effect of the gravitational fields of the Moon, Mars, the Sun, Venus and Jupiter on the mass of the visitors' bodies in comparison to their weights on earth.

The "Viking Rocket Hall" is particularly timely in view of the launching of an artificial satellite during the Geophysical Year. The exhibit, furnished by the Glenn L. Martin Company, shows a full-size Viking rocket, parts of which have been propelled to an altitude of 158 miles above the earth's surface. The rocket is cut away to show the various mechanisms it contains and their functions are explained by wall panels above them.

Surrounding the rocket are many other panels which explain the purposes of an artificial satellite and the problems attending its launching, as well as details of many of the complicated instruments involved. The actual firing of a rocket is dramatically shown in a moving model which depicts, with an accompanying sound tape, the blast-off of a Viking.

Near the south entrance of the Planetarium dome is the Willetts Memorial Weather Hall. This display features a set of dials on which may be read outside temperature, barometric pressure, and wind direction and speed. These

readings are automatically registered on the dials by remote signals from a weather tower high on the roof of the Museum. Flanking this weather information center are eight dioramas which graphically illustrate and explain phases of weather in the earth's atmosphere.

The earth's daily rotation is vividly demonstrated in the Sperry Gyroscope Exhibit opposite the south entrance of the dome. Here a gyroscope can be set spinning at the touch of a button. The gyroscope, once started, maintains its real position in space, independent of the earth's rotation. A tiny beam of light reflected from a mirror attached rigidly to the gyroscope frame moves across a graduated scale and shows the rotation of the earth.

The combination of Planetarium projector and dome is ideal for instructional purposes, and is utilized in courses for laymen given during the fall and spring seasons. Courses in astronomy, navigation and meteorology are offered to the public, with sessions held once a week during the evening hours. Special school-group showings provide supplementary background for studies in astronomy. Other instructed groups include West Point Cadets, U. S. Power Squadron units, engineering classes from neighboring universities, Scouts, and a variety of others.

In the basement of the Planetarium there are two commodious classrooms which provide comfortable and quiet facilities for instruction of such groups. Near these is the workshop of the Optical Division which supervises and assists such activities as the grinding, polishing and figuring of mirrors for reflecting telescopes. The Planetarium is also available for special lectures at hours when there are no regular performances.

The Book Corner is located near the main entrance to the Planetarium on the first floor. Here visitors may receive expert help in the choice of publications on astronomy, star identification, navigation and meteorology. Also available are seasonable star charts, star-atlases, revolving star finders, postcards, prints, astronomical gadgets, pamphlets, and children's books designed to stimulate their interest in the stars.

Planetarium staff members are frequently called upon for explanations and advice about various astronomical, navigational and meteorological problems. Parties of staff astronomers have traveled to locations favorable for photographing and studying recent solar eclipses. With the recent heightened public interest in sky phenomena, the Planetarium serves as a clearing house for information to the public directly by mail and telephone and by means of the press, radio and television.

Thus, by well integrated programs and active participation in school and community functions, the American Museum-Hayden Planetarium carries out its major purpose — that of helping the public to interpret for itself the vast body of scientific knowledge about astronomy and the allied sciences in terms of its own need and desire to understand the universe.

geology and paleontology

geology and paleontology

Geology is the study of the earth in its present condition and as it was in past ages, back to the time of its origin as a planet. It is concerned with the materials composing the minerals and rocks of the earth and with the forces that have shaped these rocks into mountains, hills, valleys, lakes, oceans and all other land forms that are so familiar to us. It deals with the sequence of rocks as they were formed on the earth, with the history of the earth as revealed by rock sequences and by the fossilized remains of life contained within the rocks. Finally, it is concerned with the history of life on the earth as shown by the study of fossils.

Thus, the inclusive science of geology is made up of varied separate sciences and these are often given distinct names, such as mineralogy for the study of minerals, petrology for the study of rocks, physiography or geomorphology for the study of land forms, structural geology for the study of earth structure, stratigraphy for the study of layered rocks, and paleontology for the study of ancient life on the earth.

The Department of Geology and Paleontology at The American Museum of Natural History is concerned with the two divisions of geology that are based mainly on Museum collections — paleontology and mineralogy — although other aspects of the sciences are given some attention. But since

the work of the Museum is based to a large degree on specimens, it is in those fields of geology where specimens — fossils and minerals — are of particular importance that the work of the Department is concentrated.

The Museum has one of the great mineral collections of the world, and this collection is being studied and increased. The large fossil collections are subdivided into several categories, each under the care and direction of one or more authorities in his special field, assisted by technicians. Thus there is a collection of invertebrates, one of fishes, one of amphibians and reptiles, one of birds, and one of mammals. These collections form the core around which are built comprehensive programs of research, field studies, collecting activities, and exhibits. Thus, the exhibits are one of the end results of extended scientific work and it is only through active prosecution of basic studies upon collections and new materials that the exhibits are kept authoritative and up to date.

At the present time, the exhibits of this Department are being revised. Modern exhibits of geology and fossil invertebrates are planned for future installation.

Scientific Work of the Department of Geology and Paleontology

The scientific work of the Department is concentrated, at the present time, largely in the field of paleontology. Several programs of exploration and research are being carried forward, with the result that the collections of the Museum are being augmented and valuable new information is being published in technical papers, monographs, books and popular articles.

On death and burial, plant remains, and the shells and hard skeletons of mollusks, crustaceans and other invertebrates, are readily fossilized and preserved in the rocks. Indeed, many rock strata are largely composed of these fossil remains. Invertebrate remains are especially abundant in rocks that were formed as sediments in ancient seas which, at various times, covered almost all of the globe. Because of this abundance, invertebrate fossils occupy a favored place in deciphering the history of the earth and in the practical service of man.

The fossil invertebrates of each geologic epoch are distinctive, so that, in general, they serve as the principal standards for the classification and dating of rock strata, especially those of marine origin. This is of great practical importance in mining, quarrying and in the search for petroleum. Happenings in the development of the earth are referred to a standard geologic time scale which was founded on the paleontological record, especially that of the invertebrate fossils. The evolutionary history of these animals goes back more than a half billion years, to the Proterozoic era, well before the advent of the vertebrates and the land plants.

Very small invertebrate fossils, such as the skeletons of protozoans, are commonly brought to the surface as oil wells are drilled, furnishing needed information on the relative position of each formation that is being penetrated, thus, in fact, guiding the drilling activity.

An active program of research in invertebrate paleontology, involving laboratory studies and field expeditions to various parts of the world, is being maintained. Studies in recent years have emphasized the important contribution that fossil invertebrates make in understanding ecological conditions of past seas early in geologic time. Recent investigations have centered around marine fossils of Permian age in South America and western Texas. Extended studies have been made of fossil organic reefs and their enclosed fossils in the Permian rocks of western Texas. This program includes comparative studies of modern coral reefs in the Bahama Islands and the South Pacific.

The fossil remains of animals with backbones are first found in rocks of Ordovician age, and they continue throughout the fossil record from that time until the present. These fossils record the evolutionary history of the vertebrates beginning with the fishes and ranging through the amphibians, reptiles, birds and mammals. Since the vertebrates have lived in many environments, their fossils are found in rocks formed from continental fresh-water sediments as well as from marine sediments.

Like the fossil invertebrates, the fossil vertebrates can be used for dating the rocks in which they occur, and in this respect they are of particular importance in the study of continental sediments, in which fossil invertebrates generally are not numerous.

The research program in fossil fishes currently involves the study of various groups of higher bony ray-finned fishes from the age of Dinosaurs and the early part of the Age of Mammals. One of the aims of this work is to obtain information on the history and relationships of the modern bony fishes. The Museum's fossil fish collection, which is one of the best of its kind, has an important role in these studies, and it is being improved constantly by Museum expeditions, exchanges with other institutions and gifts from all parts of the world.

The present research program on fossil amphibians and reptiles emphasizes the study of Triassic reptiles from various parts of the world. The purpose of this research schedule is to make known the animals that lived just before and during the early stages of the Age of Dinosaurs, a critical time in the evolution of reptiles. Extensive explorations have been carried on and collections made in the southwestern United States since the war, and much new material has been unearthed. In addition, field studies have been made in certain foreign countries.

In the field of fossil mammals, work is directed especially toward the collection and study of the primitive mammals that lived during early Tertiary times and of the advanced mammals that inhabited North America during the final phases of the Cenozoic era. Active collecting programs are being followed in the southwestern part of the United States for early Tertiary mammals, and in various sections of the west for the later mammals of the Cenozoic. Many fossils and new faunas have been found, to expand greatly

Trilobites. *Primitive crustaceans called trilobites were abundant in the early Paleozoic seas. These specimens (Dalmanites) were found in the Devonian rocks of New York State.*

our knowledge of the mammals that lived on the earth in former days. Much research is also being done on ancient South American mammals and on other problems of the evolution of this dominant group of animals.

All of this work on fossils reconstructs the history of life. It adds to our record of animals through time, and gives much new evidence for the interpretation of evolution. In addition, the research that is being carried on at this Museum is concerned with the former distribution and association of animals in the world, and the bearing that such information has upon the past relationships of continents and the history of climates.

The history of life helps us to understand the origin, nature and destiny of man. Paleontology, as studied at this Museum, is concerned with concepts, and of these the concept of evolution is one of the most vital in our modern world. No single idea has revolutionized thought in modern times so much as the theory of organic evolution. And, in the study of evolution, the evidence and interpretation of fossils is of the utmost importance.

MINERALS AND GEMS

Minerals are nature's chemicals, and mineralogists have been able to recognize over 1700 different species. ***The Morgan Memorial Hall of Minerals and Gems*** is one of the outstanding collections of these minerals in America and, in fact, in the world today. Displayed here are many rare and unusual specimens, some of particular beauty. With few exceptions all of the known minerals are represented in this collection. Some minerals are so rare that only single examples exist, while many are so common that they are present almost everywhere in the earth's crust.

A study of the earth's crust shows that it consists of different kinds of rocks, a few of which have familiar names such as granite, marble, sandstone

and slate. We see these rocks around us every day; they form our mountains and canyons, and many of our buildings. On closer examination it is found that each rock is composed of individual substances which we call minerals. For example, a handful of sand from the seashore can be separated into various kinds of grains, and these grains frequently represent a variety of minerals. Each has definite properties of hardness, density, luster, color and transparency. These different kinds of substances, then, which nature has used to make up sand and the other materials of the earth's crust are called minerals. All of the various minerals may be classified on the basis of their chemical composition as shown in the accompanying table on page 56.

The primary task of the mineralogist is to understand the physical, chemical and historical aspects of the earth's crust. The science of mineralogy is, therefore, an integrated field of study related to geology on the one hand, and to physics and chemistry on the other. What does a professional mineralogist do? For example, if he wants to study a new mineral deposit, he first must have an understanding of the geologic setting in which the minerals are found, and he gains this by examining and mapping the rock formations in the field. Without this knowledge it would be impossible to speculate intelligently as to the origin of the deposit. Next, each mineral must be identified in the laboratory. Some minerals may be determined by inspection, whereas others yield their identity only through chemical tests or the measurement of optical constants by microscopic means, or in other ways. At times, the mineralogist may make x-ray diffraction patterns of his minerals, since a crystalline substance will give a regular pattern recorded on photographic film when subjected to x-rays. The intensity and positions of these lines are characteristic for each crystalline substance. He may, in addition, employ tools borrowed from the chemist and physicist, such as differential thermal analysis in which he subjects the mineral to a gradual rise in temperature, and observes the characteristic chemical changes which take place. Or he may use spectrographic measurements which are useful in detecting minor elements which might be unnoticed by the usual qualitative chemical procedures. After all of the minerals of a deposit have been identified, the sequence of deposition can be worked out. Once this is known, the mineralogist can speculate as to the origin of the minerals and the nature of the conditions that gave rise to them.

All of the knowledge that the many mineralogists have gained after years of patient observation and study have been arranged in systematic form, and make up the science of mineralogy which may be outlined as follows.

Crystallography — An important branch of mineralogy which is concerned with the internal arrangement of atoms and the external geometric forms exhibited by minerals.

Physical mineralogy — This includes a consideration of the various physical properties such as hardness, cleavage, color, specific gravity, magnetism, electrical properties, tenacity, as well as optical properties.

Chemical mineralogy — The various chemical properties, and also the origin and formation of minerals are considered. This includes chemical analysis, spectrographic techniques, x-ray fluorescence, and thermal analysis.

Descriptive mineralogy — This is a systematic listing of the various crystallographic, physical and chemical properties of minerals, and something of the environments in which they are found.

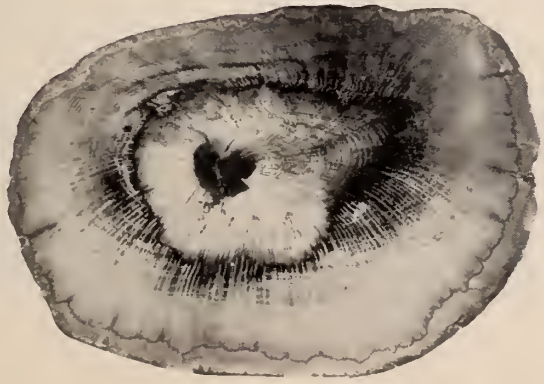
Determinative mineralogy — A classification of minerals based on physical properties and chemical composition which facilitates identification.

Mineral substances and products are indispensable to the welfare, health and standard of living of modern man, and are among the most valued and jealously guarded of the natural resources of a nation. The outstanding characteristic of the industrial era in which we live is the wide application of machinery and the use of power. In the last analysis the significance of this civilization lies in the substitution of power machinery for animal muscle. This includes everything that has come to our generation through the steam engine, dynamo, automobile, airplane and telephone. The inventions have brought about the use of minerals in an ever-increasing quantity, and an ever-widening application. Thus, as industrial techniques have become more complex, minerals that contain metals with peculiarly dis-

Upper left: Quartz. *This large crystal from St. Gotthard, Switzerland, has smaller crystals of quartz growing on its surface. Many minerals occur as inclusions in quartz and in this instance actinolite needles penetrate the quartz.*

Lower left: Opalized Wood. *Opal is often found as the replacing material in fossil or petrified wood. Petrified wood is formed by ground water dissolving the woody matter and replacing it by silica.*

Right: Stibnite. *A sulfide of the semi-metallic substance known as antimony. The mineral is the chief source of antimony and the specimen illustrated came from Inyo, Japan.*



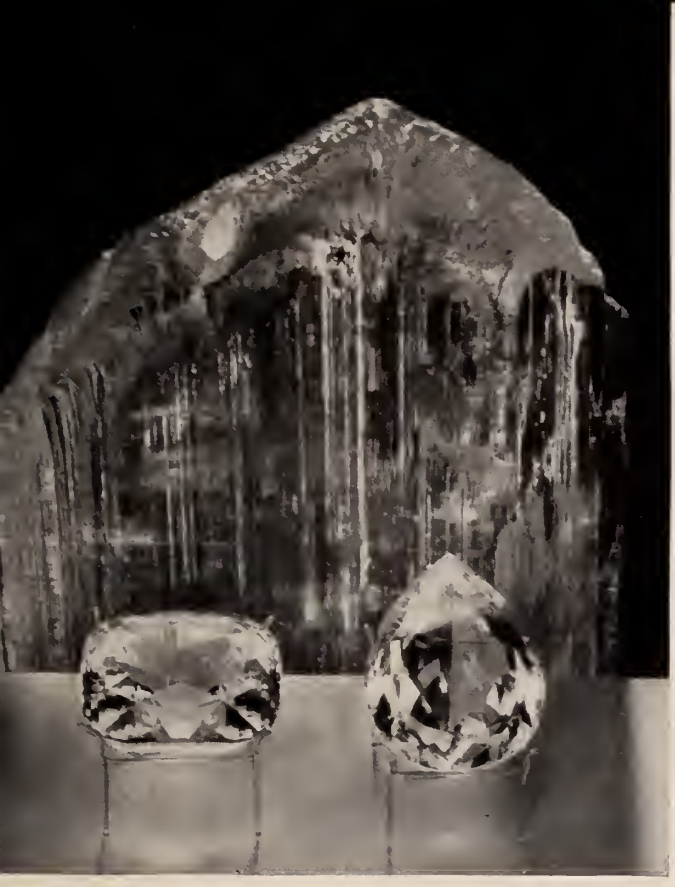
tinctive properties such as aluminum, vanadium, tungsten, molybdenum, chromium, cobalt and nickel (previously of interest only in the laboratory) have assumed real economic importance. For example, platinum, in addition to its use in jewelry, is a necessary catalyst in sulphuric acid making, and acts as a key which unlocks a cheap process of chemical synthesis. Antimony is essential to the production of clear printing type metal, and mercury is a key metal in precise scientific instruments. All of the common materials used in modern building, such as steel, cement, brick, glass and plaster have their origin in minerals. The world demands more food, and as a result the phosphates, potash and nitrates bulk large in the commodities of commerce.

The methods of the mineralogist are used every day to solve practical problems such as the manufacture of abrasives, ceramics, refractories, synthetic crystals and steel. Mineralogy is an everyday tool with the mining geologist and should be for the prospector in order that he may identify properly the minerals which he finds. He must also know something of certain mineral associations, which are so characteristic that they may be important leads to the presence of others. Mineralogy has been of direct help in military operations.

Recently, the search for and study of radioactive minerals has become of great interest to mineralogists since these minerals form the basis for future atomic energy. Clays are being investigated as a possible guide for the location of mineral deposits. Surprisingly enough, mineralogists are being of help to medical science. Since many parts of our body contain crystalline substances similar to minerals, they are capable of being studied by mineralogical techniques.

The Morgan Memorial Hall of Minerals and Gems is, in general, arranged according to the chemical classification of minerals shown on the

Barite. *These tabular crystals of barite on dolomite have come from Frizington, Cumberland, England. Barite, the chief source of barium, is used largely in the paint industry and to a lesser extent as a filler in paper and cloth, in cosmetics, and for barium meals in medical radiology tests.*



Left: Kunzite. *Kunzite is the clear lilac to pink variety of spodumene.*

Right: Silver. *Illustrated is a beautifully reticulated group of silver crystals.*

accompanying table on page 56. Specimens from all these groups are exhibited. The wall panel assemblage is a key exhibit to the large and more detailed collection in the flat cases occupying the remainder of the room, with the exception of the center aisle, which contains particularly fine specimens of gem minerals. As one progresses around the room, beginning with Panel A (at the left of the entrance) containing the native elements, it is evident that many of the minerals form regular solids with smooth faces which are characteristic of each mineral species. These regular forms are called crystals and are the external result of the unhampered growth and arrangement of the minute internal particles called atoms. The collection also has a number of fine wooden crystal models available for study. The recently acquired gold specimens from the William Boyce Thompson Collection are excellent examples of the crystallization of the native element gold. The sulphur crystals in Panel A are another good example of crystallization. Well developed crystals of the important iron mineral, hematite, are displayed in Panel M.

There are several rare crystals of barite, one of the sulfates, and a barium mineral in Panel AA.

Certain minerals among the many hundreds of different species are of particular value and we call them gems, because they appeal to our sense of beauty. The qualifications which make minerals gems include beauty of color, a certain degree of transparency that permits the color qualities to be developed by cutting and polishing, and sufficient hardness to preserve them against wear. In addition, the value of gems is governed largely by their rarity, together with a fluctuating unknown dictated by fashion.

The Morgan Collection contains several outstanding gems, including the De Long Star Ruby, and the "Star of India," the largest star sapphire in the world. There are also notable diamond crystals, as well as glass models of the world's famous diamonds, both in the natural state and after cutting. Several fine specimens of chrysoberyl are in the collection. Occasionally, this aluminate of beryllium contains hair-like inclusions arranged in parallel bundles, and when cut and polished is known as "oriental cat's eye." The specimen from Kandy, Ceylon, is thought to be one of the world's finest.

Table of the
Chemical Classification of Minerals

Elements — About 20 elements in an uncombined form are found as minerals, and are said to occur in the native state.
Example, gold, Au

Sulfides — These minerals consist principally of combinations of the various metals such as copper and lead with sulfur, selenium, or tellurium. The majority of the metallic ore minerals are in this class.
Example, galena, PbS

Sulfosalts — Minerals composed of lead, copper, or silver combined with sulfur and antimony, arsenic, or bismuth are included in this class.
Example, enargite, Cu_3AsS_4

Oxides — a. Anhydrous oxides. The minerals of this class contain a metal in combination with oxygen.
Example, hematite, Fe_2O_3

b. Hydrous oxides. The mineral oxides that contain water or the hydroxyl (OH) as an important radical are included in this class.
Example, diaspore, $Al_2O_3.H_2O$

Halides — This class includes the chlorides, fluorides, bromides, and iodides.
Example, fluorite, CaF_2

Carbonates — The minerals whose formulas include the carbonate radical, CO_3 are in this group.
Example, calcite, $CaCO_3$

Nitrates — The minerals in this class can be considered salts of nitric acid and contain the NO_3 radical.
Example, niter, KNO_3

Borates — The borates are salts of boric acid.
Example, borax, $Na_2B_4O_7.10H_2O$

Phosphates — Minerals whose formulas include the phosphate radical, PO_4, comprise this group.
Example, apatite, $Ca_5(F,Cl)(PO_4)_3$

Sulfates — Minerals whose formulas include the sulfate radical, SO_4 are in this class.
Example, barite, $BaSO_4$

Tungstates — The few minerals whose formulas include the tungstate radical, WO_4, comprise this group.
Example, scheelite, $CaWO_4$

Silicates — The minerals included in this group form the largest class among minerals. They contain various elements, the most common of which are sodium, potassium, calcium, magnesium, aluminum, and iron, in combination with silicon and oxygen.
Example, quartz, SiO_2

FOSSIL FISH ALCOVE

The known history of the fishes covers a time span of about 400 million years. During this long interval four main groups or classes of fishes were evolved. The first group, called ostracoderms, were jawless and had well developed bony armor. They were the ancestors of the living lampreys and hagfishes. Some time during the Silurian period, the ostracoderms gave rise to the second major category, the placoderms, which were the first fishes with jaws. The placoderms evolved into a number of distinct types, most of them with heavy, bony armor and mobile, paired fins. They were the first rulers of the Devonian lakes and seas.

The sharks and their relatives comprise the next main group of fishes. They evolved from primitive placoderms, probably in the Silurian, although the earliest remains of sharks are found in Devonian deposits. Early sharks and sharklike forms were numerous and varied during the Carboniferous or Coal Age. The group declined in the Permian and Triassic periods, becoming more successful again in the Jurassic with the rise of the types living today.

The fourth class includes all the higher bony fishes. This large and varied assemblage likewise had a placoderm origin, probably during the Silurian period. At the time of their first appearance in the fossil record, the bony fishes were already separable into two subclasses: the ray-finned forms that evolved into the common fishes of today, and the fishes with lobed fins. The ray-finned types separated into numerous evolutionary lines before the Mesozoic era or Age of Dinosaurs. The lobed-finned fishes included the crossopterygians and the dipnoans or lungfish. These earliest lung breathers were particularly numerous during the Devonian period. The crossopterygians are of great interest since they gave rise to the first land-living verte-

brates. They are represented today by a single form, a fish called *Latimeria*, which lives in the coastal waters of South Africa. The lungfishes, once widely distributed, have persisted to the present time in South America, Africa, and Australia.

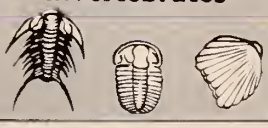
The history of the fishes, as briefly summarized above, is illustrated in a series of simplified, synoptic exhibits in the Fossil Fish Alcove which is located at the west or far end of the First Fossil Hall. The visitor should walk in a counterclockwise direction within the Alcove when examining these exhibits, beginning with the family tree of the fishes which is to the right of the Alcove entrance.

Suspended above the entrance to the Alcove are the restored jaws of a Miocene fossil shark *(Carcharodon megalodon)*. The plaster jaws are modeled after those of a living relative and they support the actual fossil teeth. This giant shark, which is closely related to the modern white-shark or man-eater, attained an estimated length of 46 feet.

Inside the Alcove, is a simplified family tree of all the major groups of fishes discussed in the introductory paragraphs. It illustrates in graphic form the complexity of fish evolution and points out the relationships and classification of the major groups. If the visitor is interested in the details of fish evolution, it may prove helpful to refer to this tree from time to time while examining the other exhibits in order to note the relationship of a particular group to the others.

Moving from right to left, the next exhibit is devoted to the oldest known vertebrates, the jawless fishes or ostracoderms. Typical examples of these ancient, armored forms are reconstructed in the models, while the cut-outs show some details of structure and variation in the form of the head armor. The ostracoderms include both bottom-dwellers and more active swimmers. In the left half of the same case are examples of the first jawed fishes, the placoderms. They existed in great variety during the Devonian period. The acanthodians were the most generalized types and they lasted into the Permian period. The others, which became extinct at the end of the Devonian, developed a variety of body shapes and elaborations of the bony armor. *Coccosteus* and his larger relative *Dinichthys* were predators; *Bothriolepis* and such types as *Lunaspis* were bottom-feeders. On the wall above the fire exit is a model of *Dinichthys* in the act of overtaking some primitive Devonian sharks *(Cladoselache)*.

The next case on the left illustrates the long history of the sharks and their distant relatives the chimaeroids or ratfishes. Because the shark skeleton is made of cartilage, which disintegrates rapidly, it is rarely fossilized. Under exceptional conditions, however, shark skeletons were preserved, and in one Devonian form *(Cladoselache)* even some muscle and kidney tissue was fossilized. Shark teeth, by contrast, are among the commonest of vertebrate fossils. Examples of the main types of teeth are

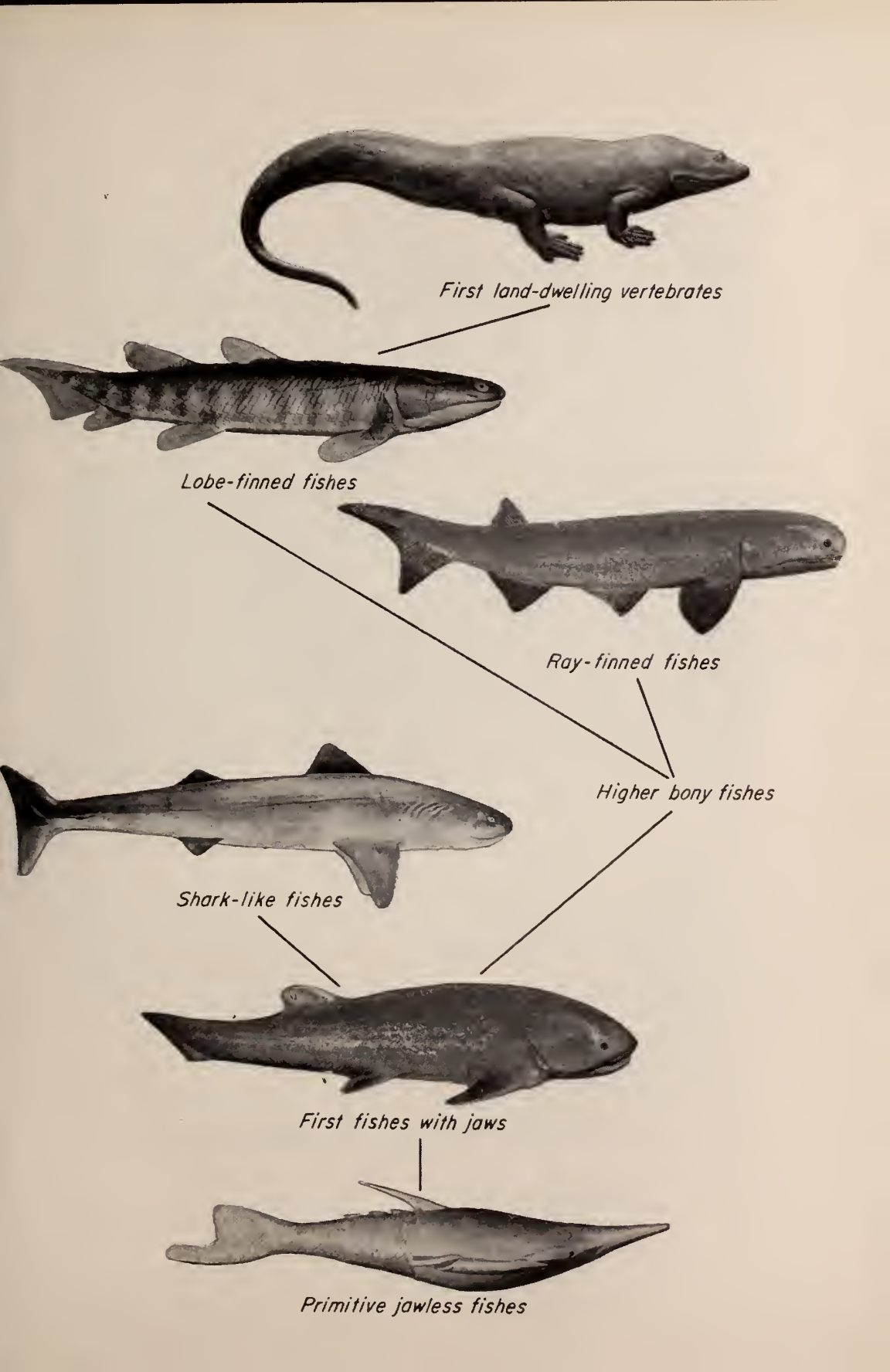
TIME SCALE	ERAS	DURATION OF PERIODS	PERIODS			DOMINANT ANIMAL LIFE
			Quaternary	EPOCHS	Recent Pleistocene	Man
10 20 30 40 50 60 70	CENOZOIC 70 MILLION YEARS DURATION	70	Tertiary	EPOCHS	Pliocene Miocene Oligocene Eocene Paleocene	 Mammals
80 90 100	MESOZOIC 120 MILLION YEARS DURATION	60	Cretaceous			
150		35	Jurassic			
		35	Triassic			Dinosaurs
200	PALEOZOIC 350 MILLION YEARS DURATION	30	Permian			 Primitive Reptiles
250		25	Pennsylvanian			
		25	Mississippian			
300		40	Devonian			 Amphibians
		30	Silurian			
350		70	Ordovician			 Fishes  Invertebrates
400						
450		80	Cambrian			
500						
Figures in millions of years	PROTEROZOIC ARCHAEOZOIC	Figures in millions of years	2500 + MILLION YEARS DURATION			BEGINNINGS OF LIFE

displayed in this case. Fossil chimaeroids are known mostly from their teeth. The Paleozoic forms, called bradyodonts, had their teeth arranged as crushing plates and presumably they were mollusk eaters. The skull and some parts of the skeleton are preserved in the Carboniferous *Helodus*. The later chimaeroids, leading to the living marine *Chimaera*, are represented mostly by dental plates and spines.

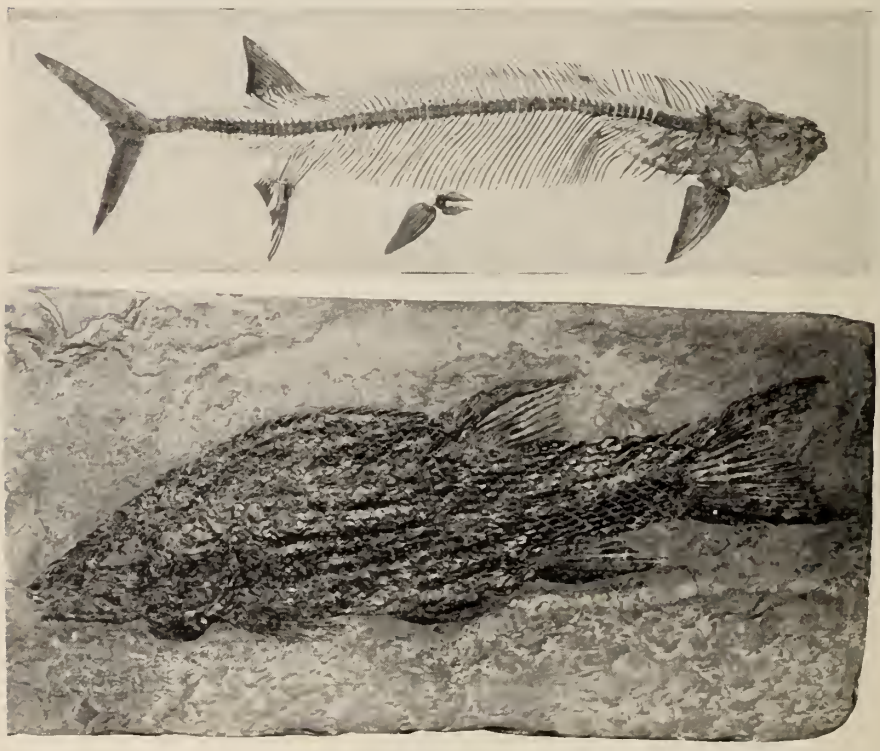
The diorama represents a middle Devonian underwater lake scene about 300 million years ago. The fishes that swam in this lake are now preserved as fossils in the flagstones around Achanarras, Scotland, where they occur in considerable abundance. The models show the fishes as they appeared in life, although their coloring is, of course, hypothetical. The various types of fishes that lived together in this ancient lake — placoderms, primitive ray-finned forms, crossopterygians and lungfish — make up the fossil fish fauna of the Achanarras deposit. The vegetation, a simple aquatic plant or alga and submerged stems of the earliest land plants, also existed in middle Devonian time.

The exhibit to the right of the fire exit outlines the complex history of the bony ray-finned fishes or actinopterygians. This large and diverse group is usually divided into three subgroups which actually represent broad, successive stages of specialization. These subgroups are termed the chondrostean, holostean and teleostean, typified by the sturgeon, the gar and the perch. The primitive chondrosteans, of which the Devonian *Cheirolepis* is a good example, developed a number of evolutionary lines that independently reached the holostean level. Thus, such holosteans as the modern gar and bowfin *(Amia)* had a separate ancestry beginning some time late in the Paleozoic era. The teleosts, including the great majority of living fishes (herring, catfish, perch, halibut, etc.) probably arose from a single ancestral stock in the Jurassic period. Since that time they have had an explosive evolution: there are more families of teleosts than in all the other major groups of fishes put together. On the wall above the shark exhibit is the fossil skeleton of a large Cretaceous teleost, *Portheus molossus*, from the chalk beds of Kansas.

The final exhibit, next to the Alcove entrance, considers the fishes with lobed fins. The presence of internal nostrils in some of these fishes indicates that they came to the surface for air-breathing, and that they had lungs in addition to gills. The central portion of the case shows the changes that occurred in the skull roof, the front or pectoral fin and the backbone during the transition from a primitive crossopterygian fish to an early land-living vertebrate or amphibian. This great event in vertebrate evolution took place in the Devonian period when seasonal droughts forced the crossopterygians to move over the dry stream beds in search of water and thus to explore the possibilities of land existence. The history of the coelacanth fishes, which arose from the Devonian crossopterygians, is illustrated on the right, ending in the living *Latimeria*. On the left are the fresh-water lung-


First land-dwelling vertebrates
Lobe-finned fishes
Ray-finned fishes
Higher bony fishes
Shark-like fishes
First fishes with jaws
Primitive jawless fishes

fishes or dipnoans, likewise descended from the Devonian crossopterygians. Both the coelacanths and the dipnoans evolved slowly, the modern representatives showing a marked resemblance to their ancestors.



Above: A Giant Cretaceous Teleost Fish. *Portheus lived in a large inland sea that covered much of central North America in late Cretaceous time. This specimen was discovered in the chalk beds of western Kansas. Below:* A Triassic Ray-Finned Fish. *Semionotus was a probable ancestor of the modern gars.*

BRONTOSAUR HALL

The Brontosaur Hall is dominated by the skeletons of three upper Jurassic dinosaurs, placed on a large island in the middle of the hall. The largest of the three skeletons, that of *Brontosaurus*, is almost seventy feet in length and is some eighteen feet high at the hips. In life *Brontosaurus* must have weighed thirty or forty tons. The aggressive, meat-eating dinosaur, *Allosaurus*, probably preyed upon the big, inoffensive plant-eaters such as *Brontosaurus*, and in this group *Allosaurus* is mounted as if feeding upon a brontosaur backbone. The third dinosaur in the group is the plated dinosaur, *Stegosaurus*, another plant-eating form.

A truly dramatic exhibit in this hall is the series of original brontosaur tracks, set into the base of the central dinosaur island. This track-way was excavated near Glen Rose, Texas, and reassembled in the Museum. In it

are to be seen six forefoot and six hindfoot impressions made by a gigantic brontosaur as it tramped through a limy mud millions of years ago. The three-toed tracks of an allosaur follow those of the brontosaur, and since two of the allosaur tracks are super-imposed upon two of the large brontosaur tracks, it is evident that the meat-eating dinosaur was actually following the big plant-eater. Here, preserved in stone, is a story from the geologic past!

The walls of the Brontosaur Hall are decorated with mural drawings illustrating some of the animals that lived during the late Paleozoic and Mesozoic eras, The Age of Reptiles. Several assemblages of animals — or faunas — are illustrated. These include the amphibians and reptiles that lived during the Permian times in what is now Texas, the Permian reptiles found in the Karroo desert of South Africa, the Chinle fauna of Triassic age from the southwestern part of the United States, the Morrison fauna that spread over western North America in the late Jurassic times, the Belly River fauna of western Canada, and the Lance fauna, the last of all dinosaurian faunas in North America. Also are shown various marine reptiles that lived during the Age of Reptiles, when dinosaurs ruled the land.

The exhibits in the wall cases of this hall are arranged in a sequence that begins at the west end of the hall, near the entrance to the Alcove of Fossil Fishes. On the left side of the doorway is a case illustrating the origin and evolution of the first land-living vertebrates, the amphibians. This exhibit shows how the amphibians arose from fishes and how they developed along several evolutionary lines, the most important of which is that of the labyrinthodont amphibians. In the labyrinthodonts of Permian times, as represented by *Eryops*, shown here by skulls and a skeleton, the amphibians reached the culmination of their evolutionary development and for a brief time were in active competition with the reptiles for dominance of the land. The last of the labyrinthodonts lived in the Triassic period and are exemplified by *Buettneria*, more properly known as *Eupelor*. With the close of Triassic times the labyrinthodonts became extinct, but before dying out they gave rise to the frogs and toads. Various other amphibians were contemporaneous with the labyrinthodonts, such as the bizarre animals represented in this exhibit by the genus *Diplocaulus*, a flat creature with an excessively broad skull, shaped rather like an arrowhead.

In this case are also to be seen the first reptiles, derived from amphibian ancestors. The transition from the amphibians into the first reptiles was so gradual that it is difficult to draw a distinct line between the two classes of vertebrates. *Seymouria* is such a perfect intermediate form that the problem of whether it is properly an amphibian or a reptile is the subject of much scientific debate. A cast of the earliest known reptilian egg is seen as the central theme in this exhibit of the first reptiles; the original, in the Museum at Harvard University, was found in Permian sediments in north central Texas. Two primitive reptiles are exhibited in separate floor cases. One of these is *Diadectes*, from the Permian red beds of Texas; the other is

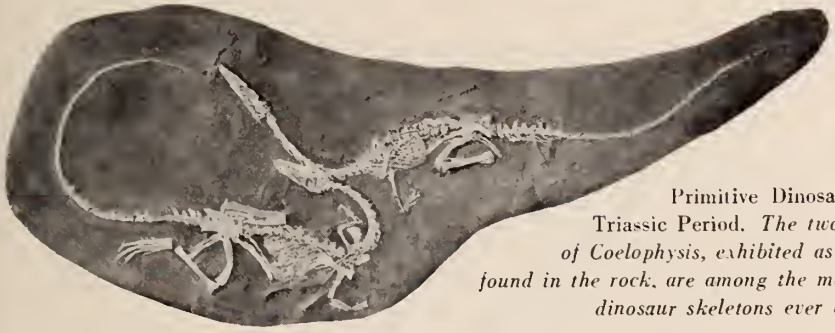
Scutosaurus, from the Permian of northern Russia.

On the right side of the doorway leading to the Fossil Fish Alcove is an exhibit of mammal-like reptiles of therapsids from South Africa. These reptiles reached an advanced stage of evolution at an early date and some of them were directly ancestral to the mammals. In the center of the exhibit is a rare skeleton of one of the mammal-like reptiles, *Lycaenops*. Some therapsids developed along lines that were not directly ancestral to the mammals, but rather toward other areas of specialization. The dicynodonts were large, plant-eating therapsids in which the teeth were suppressed except in the male animals, which had a pair of upper tusks in the skull. The titanosuchians were large, carnivorous therapsids, and the dinocephalians were herbivorous forms. A skeleton of *Moschops*, one of the dinocephalians, is exhibited in a separate floor case.

Along the south wall of the hall, opposite the skeleton of *Allosaurus*, is a range of cases exhibiting pelycosaur reptiles from the Permian beds of Texas and Oklahoma. The pelycosaurs were related to the mammal-like reptiles of South Africa. They were frequently specialized in rather strange ways. For instance, the predaceous form, *Dimetrodon*, had a large sail on its back formed by an elongation of the spines of the vertebrae. *Edaphosaurus*, a water-dwelling, mollusk-eating pelycosaur, also had a huge sail on the back, in this case complicated by numerous bony cross-bars like the yardarms on the mast of an old sailing vessel. The purpose of these sails is entirely a matter of conjecture. *Cotylorhynchus* was a large, heavy pelycosaur with a small skull.

Across the hall from the exhibit of Permian pelycosaurs is a series of cases in which are seen Triassic reptiles that lived during the early part of the Age of Dinosaurs. In the Triassic period reptiles other than dinosaurs were dominant, especially the large phytosaurs, of which a skeleton and some skulls are shown here. The phytosaurs, although they looked much like crocodiles, were not of crocodilian relationship. They preceded the crocodilians, and it was only after the phytosaurs became extinct, at the end of the Triassic period, that the crocodilians began their evolutionary development. The large slab of phytosaur bones exhibited in this case was found beneath the palisade cliffs of the Hudson River, about a half-mile south of the George Washington Bridge. Another fossil of local origin is the small skeleton of the primitive reptile *Hypsognathus*, discovered in a rock quarry between Clifton and Passaic, New Jersey. *Hypsognathus* was the last of the cotylosaurian reptiles, and is related to some of the Permian cotylosaurs that are exhibited in the southwest corner of the hall.

A skeleton of a Triassic dinosaur, *Plateosaurus*, one of the largest of the early dinosaurs, is displayed nearby. This specimen, from the upper Triassic sediments of Germany, represents a stage of evolution ancestral to the giant sauropod dinosaurs, such as *Brontosaurus*. Of particular importance in the study of dinosaurs are the skeletons of a primitive Triassic theropod.



Primitive Dinosaurs of the Triassic Period. *The two skeletons of Coelophysis, exhibited as they were found in the rock, are among the most perfect dinosaur skeletons ever discovered.*

exhibited in the wall cases on the north wall and toward the east end of the hall. These skeletons, of the genus *Coelophysis*, were excavated several years ago at Ghost Ranch in New Mexico, and they are among the most complete dinosaur remains ever discovered. Numerous skeletons, complete to the smallest bones and fully articulated, were found at Ghost Ranch. These represent animals in various stages of growth, and together they give us detailed information about the primitive dinosaurs. In this same case is a family tree of the dinosaurs, illustrated by scale models.

Across the hall, on the south wall, is a case containing an exhibit of Morrison dinosaurs, contemporaneous with the skeletons that are displayed on the center island.

At the east end of the hall, on either side of the doorway that leads into the corridor, are exhibits that illustrate such topics as the means of locomotion, defense, method of feeding, and the geologic and geographic distribution of the dinosaurs.

In the corridor between the Brontosaur and Tyrannosaur Halls are displayed marine reptiles that lived during the Age of Dinosaurs. Here are seen the fish-like ichthyosaurs, numerous in Jurassic and Cretaceous seas. A series of ichthyosaurs from Jurassic sediments in Germany show stages of growth. Also a mollusk-eating marine reptile, *Placodus*, is exhibited here, and in addition some plesiosaurs, including a fine skeleton from the upper Jurassic of England. On the wall of the corridor opposite the entrance to this hall is the skeleton of a giant mosasaur of Cretaceous age. The mosasaurs were lizards that became adapted for swimming and developed to great size.

TYRANNOSAUR HALL

The Tyrannosaur Hall is devoted largely to the dinosaurs that lived during the Cretaceous period, immediately before the dinosaurs became extinct. Although other reptiles are exhibited in this hall, dinosaurs are dominant, as is evident from the large skeletons in the center of the hall and around the walls.

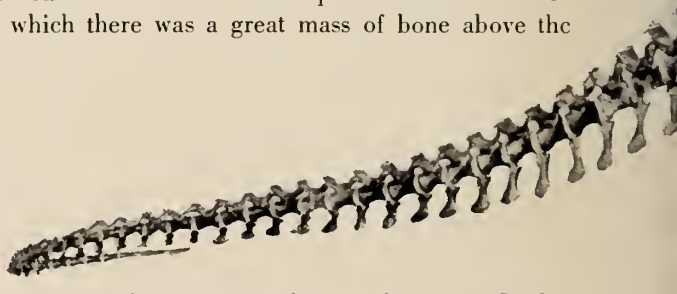
In the center of the hall are the skeletons of three large dinosaurs that lived together at the very end of Cretaceous times. These are *Tyrannosaurus*,

the largest of the carnivorous or meat-eating dinosaurs and the largest flesh-eating animal ever to live on the land; *Triceratops*, a horned dinosaur that lived upon plants; and *Trachodon*, an aquatic dinosaur, also a plant-eater.

The skeleton of *Tyrannosaurus* is some 45 feet in length, and as mounted it stands about 20 feet high at the top of the head. The huge skull, armed with sharp teeth, is in a case on the floor where it can be seen near at hand; a plaster replica is placed on the skeleton. Skeletons of *Gorgosaurus*, a predatory dinosaur similar but not quite so specialized as *Tyrannosaurus*, are seen on either side of the doorway at the south end of the hall. At this end of the hall are displayed also the skeletons of *Ornithomimus*, a comparatively small and lightly-built theropod dinosaur, related in a general way to the large carnivores just described. *Ornithomimus* was adapted for swift running and for feeding upon fruits and small animals.

Trachodon is often called a "duck-billed" dinosaur because the front of the skull is flattened and expanded into a sort of bill. Because of this skull structure it is probable that *Trachodon* shoveled in the mud at the bottom of rivers and lakes for its food. There are various indications that this was an aquatic dinosaur, among them being a remarkable petrified mummy, displayed near the mounted skeletons, in which not only the bones but also the skin are preserved. This specimen shows that the skin in the duck-billed dinosaurs was of leathery texture, and that there were webs between the toes of the front feet, as might be expected in a swimming animal. Other members of this group represented in the hall by skeletons are *Corythosaurus*, *Saurolophus* and *Procheneosaurus*. Also there is a case showing the evolution of the skull in the duck-billed dinosaurs. Many of these reptiles developed large crests on the top of the skull, formed by an upgrowth of the premaxillary and nasal bones, and these contained extended loops of the nasal passages.

Related to the duck-billed dinosaurs were the peculiar troodonts or bone-headed dinosaurs, in which there was a great mass of bone above the



brain. These animals reached the culmination of their evolution in *Pachycephalosaurus*, a skull of which is exhibited.

The horned dinosaurs, or ceratopsians, were plant-eaters, well adapted for defending themselves by fighting. They were something like rhinoceroses in the modern world. The skeleton of *Triceratops* shows the characteristic pose of a ceratopsian dinosaur, with the huge head lowered to present the three long, sharp horns at an adversary. These dinosaurs had a large frill

The Giant Carnivorous Dinosaur (Tyrannosaurus). *This late Cretaceous dinosaur was the largest of all land-living, meat-eating animals. It preyed upon other large dinosaurs.*

on the back of the skull, which served in part as a protection for the neck and in part as an enlarged area of attachment for heavy jaw and neck muscles. Various horned dinosaurs other than *Triceratops* are on display, notably *Monoclonius*, with a single large horn on the nose and *Styracosaurus*, with spikes around the frill of the skull, in addition to the nasal horn. Of particular interest are the skeletons and eggs of *Protoceratops*, a small ceratopsian that was approximately ancestral to the larger types. The skeletons

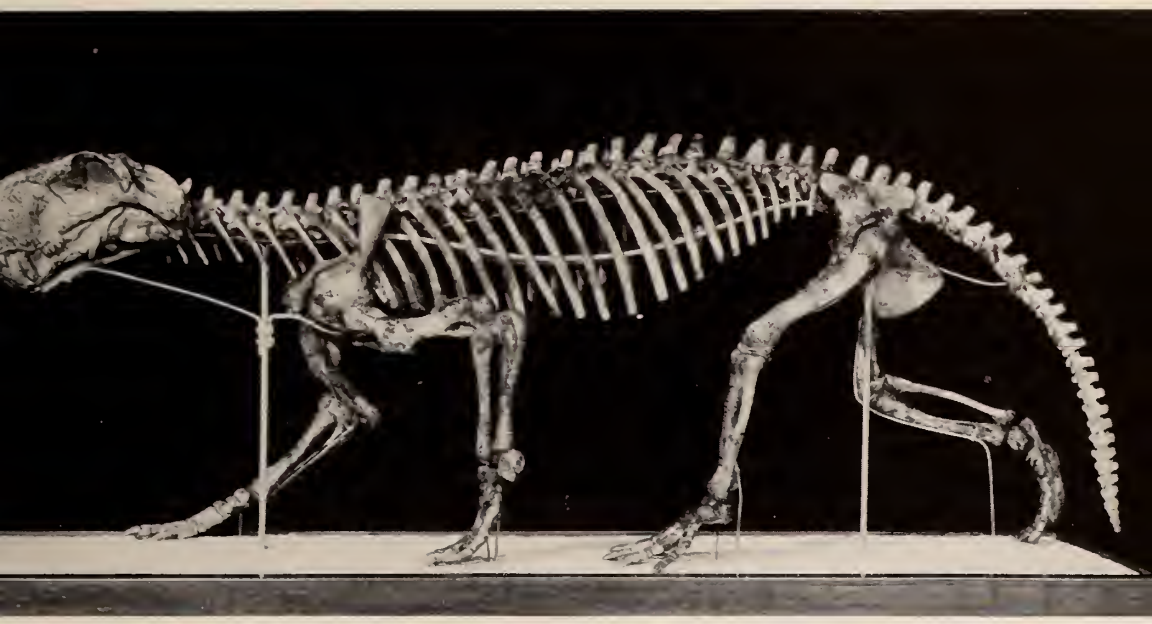
Dinosaurs and their Eggs. *Protoceratops was a small, primitive horned dinosaur that lived in Mongolia during the Cretaceous period. The two skeletons are shown with a reconstructed nest of eggs.*

and eggs of *Protoceratops* were found at Shabarakh Usu in Outer Mongolia, by the Central Asiatic Expedition of this Museum. Several nests of eggs were discovered, and in some of the eggs are fragments of fossilized embryos. These, the first undoubted dinosaur eggs to be discovered, confirmed previous speculations as to the method of reproduction in the dinosaurs.

One other group of dinosaurs, the armored dinosaurs, is exhibited in this hall by a skeleton of *Nodosaurus* with the body armor in place, and by part of a skeleton of *Palaeoscincus*. These dinosaurs were completely covered on top by heavy bony armor that protected them against attack from the large carnivorous dinosaurs of the time.

On the left side of the doorway at the north end of the hall is a display of the pterosaurs or flying reptiles. These reptiles arose in Jurassic times, at about the time the birds were first evolving, and for some time they shared the skies with the early birds. There were many forms of flying reptiles, some of them as small as sparrows, others, like the giant *Pteranodon* on the wall, with a wing spread of twenty feet or more. In these reptiles the fourth finger of the hand was elongated for a wing support, and the wing itself was formed by a large fold of skin.

On the other side of the doorway from the pterosaur exhibit is a skeleton of a camptosaur, a relative of the duck-billed dinosaurs.



A Mammal-Like Reptile *from South Africa. Lycaenops was a Permian reptile, belonging to the group of advanced reptiles that were ancestral to the first mammals. It exhibits many mammal-like characters in the skeleton.*

GIANT SLOTH HALL

The beginning of the Age of Mammals was characterized by a radical change in the kinds of vertebrate animals that inhabited the earth. The dinosaurs had disappeared at the end of the Cretaceous period, and with them the great swimming reptiles and the bizarre pterodactyls or flying reptiles. Although the mammals had already evolved from their reptilian ancestors by the Jurassic period, they did not begin to dominate the land until the beginning of the Tertiary period.

The Giant Sloth Hall, located in the southeast tower area, has been designed to illustrate a number of topics that may be logically considered with the first part of the Age of Mammals. This Hall is still being installed and will be completed within two or three years. As the visitor enters this hall from the Tyrannosaur Hall, he will notice ahead of him a large semicircular exhibition case, the right part of which is devoted to the important question of why and how animals became extinct in the geologic past. The left part shows what fossils are and how they are found and studied. Some distance in front of this case is a circular case, one half of which is devoted to a field work diorama and the other half to a three-dimensional family tree showing the relationships of the various mammalian orders.

The reptiles that survived the Age of Dinosaurs include the crocodilians, the lizards and snakes and the turtles. These groups are considered in a

series of synoptic exhibits along the corridor that leads from the Tyrannosaur to the Age of Mammals Hall. Here are seen the skull of a late Cretaceous giant crocodile, *Phobosuchus*, from Texas and the shell and skeleton of a giant Pleistocene tortoise from India.

The story of the rise of the mammals begins with an exhibit on the origin of the mammals which is located beside the entrance to the Tyrannosaur Hall. Here the visitor may compare mounted specimens of a reptile and a mammal, and note the differences in the method of reproduction of these two Classes of vertebrates as well as the differences in growth patterns. A series of models demonstrates the transformation of the skull and skeleton from reptile to mammal.

The next exhibit illustrates the first true mammals, which lived together during the Age of Dinosaurs. They are known mostly from fragmentary skulls and teeth. Together with actual specimens of these first mammals, are enlarged models of lower jaws, skulls and teeth. These have been placed on a family tree to show how they were related to each other and to their later and more familiar descendants.

The marsupials are a well-defined group of mammals including the common opossum and the kangaroo. Their most distinctive character is the usual presence of a pouch on the belly of the female, in which the young, born at a very immature stage, are carried for some time after birth. There are also various characters in the skeleton that make it possible to distinguish the marsupials, fossil and living, from the great group of placental mammals to which man belongs. The exhibit on marsupials emphasizes the separate evolution of these animals into a variety of forms, many of which closely resemble various placental mammals. The marsupials were most successful in South America and particularly in Australia where they were for long periods not in direct competition with the placental mammals. In the adjoining case is a cast of the skeleton of *Diprotodon*, the largest known marsupial.

The placental mammals were not derived from the marsupials, although they and the marsupials had a common ancestor. The placentals multiplied and diversified rapidly in the Paleocene and particularly in the Eocene epochs. Quite distinctive assemblages existed in each of these periods along with characteristic plants and invertebrate animals, as shown by the exhibits that present cross-sections of early Tertiary life.

One such cross-section includes fishes of the early part of the Age of Mammals. Although little is known about the early evolution of the advanced bony fresh-water fishes, modern types are almost unknown in the fossil record until the Eocene period. Examples are exhibited of the various fossil fishes that occur in several large Eocene lake deposits in Wyoming, Colorado and Utah. In these lakes of 50 million years ago lived garfish, herrings, catfish and numerous other forms with close recent relatives.

Across the corridor is a series of skeletons of the first hoofed mammals

Skeleton and Restoration of a Primitive Hoofed Mammal (Ectoconus). *This ancient mammal, from the Paleocene period, was quite generalized and apparently ate a variety of foods.*

or condylarths from the Paleocene and Eocene epochs. The long, low skull, short limbs and long tail were primitive characters shared for the most part with the earliest flesh-eating mammals. *Meniscotherium* was a small condylarth, about the size of a cat. *Ectoconus*, with its relatively small skull and heavy limbs had the dimensions of a large dog. *Phenacodus*, approaching the size of a tapir, represents the stock from which the odd-toed hoofed mammals (such as horses) probably arose.

Skeletons of *Coryphodon*, *Barylambda*, and *Uintatherium* represent different types of archaic hoofed mammals, descended from the primitive condylarths, that lived during the first part of the Age of Mammals. A family tree of these animals is displayed around the corner from the *Uintatherium* skeleton. In the semicircular end case to the right of the condylarths there is a skeleton of a Pliocene "earth pig" or aardvark *(Orycteropus)*. Aardvarks are living today in Africa. The structure of the aardvark skeleton suggests that this curious animal may have evolved from the condylarths, although the skull is highly specialized.

Across the alcove from the family tree of the archaic ungulates is an exhibit concerned with the important subject of historical zoogeography. Here are explained some of the factors that have influenced the distribution of animals, particularly land mammals, in the geologic past — migration, the geographic isolation of groups of animals, their radiation from a point of origin and their sequence of arrival on a particular continent.

A general consideration of historical zoogeography naturally leads to an example of animal distribution and to the evolutionary effects of this dis-

tribution on the animals themselves. At the very beginning of the Age of Mammals, North and South America were connected by the Panama land bridge. At this time, three different groups of mammals crossed the bridge into South America: primitive marsupials, the ancestors of the armadillos and sloths, and one group of early hoofed mammals. Following this invasion, the land bridge sank beneath the sea and remained submerged until just before the beginning of the Ice Age, perhaps 3 million years ago. During this long period of isolation, the early immigrants into South America evolved along diverse lines. Across the corridor is a cast of the skeleton of *Macrauchenia*, a highly specialized descendant of the condylarth immigrants. This creature probably had a short elephant-like trunk which, together with its long neck and legs, must have presented a most bizarre appearance. In this section of the hall, the visitor can examine other mammals from South America. The notoungulates, evolved from the condylarths, were extremely varied, as the exhibits show. *Toxodon* lived in the Pliocene and Pleistocene epochs and, in build, must have resembled a short-legged rhinoceros. *Scarrittia*, from the Oligocene epoch, was a distant relative of *Toxodon*.

The edentates are a distinctive order of mostly South American mammals including the anteaters, armadillos and sloths. They arose in North America and entered South America at the beginning of the Age of Mammals. The small Eocene *Metacheiromys*, a primitive edentate from North America, is exhibited in the table case opposite the entrance to the tower alcove. The ground sloths, exhibited in the tower alcove, became common early in edentate history, and *Hapalops* is a typical Oligocene-Miocene form. *Megalocnus* is one of several sloths found in the Pleistocene of Cuba. *Mylodon* and *Lestodon* were the giants of their kind, the former reaching North America after the land bridge was reestablished in the Pleistocene.

The armadillos were abundant and varied in South America by the Miocene. An early offshoot of the armadillo stock includes the glyptodons, which developed their protective armor into an immovable mass of solid, bony plates. By the Pliocene epoch they became very large, and in the Pleistocene epoch they migrated into Texas and across to Florida. *Glyptodon* and *Panochthus* are representative examples.

In the corridor near the Age of Mammals Hall is an exhibit of the first flesh-eating mammals, or carnivores, called creodonts. The creodonts lived during the first part of the Age of Mammals and their remains have been found on all the continents except South America and Australia. Most of them had long, low skulls with a small braincase. In such forms as *Oxyaena*, the dentition was of the shearing type characteristic of later carnivores. The teeth of *Mesonyx*, on the other hand, had blunt, crushing cusps. The creodonts were the ancestors of all the later carnivores — the cats, hyaenas, civets, dogs, bears, raccoons, mustelids, and also the seals and walruses.

The only placental mammals known from the Age of Dinosaurs belong to a group known as insectivores. These ancient placental mammals are

exceedingly rare and of great value in evolutionary studies. Modern insectivores include the moles, shrews and hedgehogs. Certain Cretaceous members of this group, such as the tiny *Deltatheridium* from Mongolia, must be close to the ancestral stock from which all the other placental mammals arose. The skull of this form, which is the only part of the skeleton known, is exceedingly primitive and generalized for a placental mammal. A family tree of the insectivores is displayed in a case across the corridor from the creodont exhibit.

To the right of the insectivore exhibit are two unrelated groups of early mammals descended from the insectivores. The taeniodonts inhabited North America during the Paleocene and Eocene epochs. They had high, peg-like teeth and short skulls with deep, powerful lower jaws. The limbs were short and stout. The tillodonts are known only from the Eocene epoch in North America. The skull had a small braincase and the molar teeth were low-crowned; the skeleton was rather bear-like in its proportions.

To the left of the insectivore exhibit is a three-unit case dealing with the evolution of the primates, the order of mammals to which man belongs. The primates evolved from the insectivore stock at the beginning of the Paleocene epoch. During the Paleocene and Eocene the early primates were numerous and divided into a number of separate evolutionary lines. Many of these then became extinct, but some continued on through the Age of Mammals to produce lemurs, *Tarsius*, the New and Old World monkeys, the apes and, of course, man — all living today.

Titanotheres. *These long-extinct relatives of the horses and rhinoceroses began as small animals about the size of a fox (Eotitanops, right, and Brontops, center). The last of the titanotheres such as the Brontotherium (left) had horn-like processes on the skull.*

AGE OF MAMMALS

Osborn Memorial

The fossil record for a few groups of mammals is unusually complete, and it is possible to follow evolutionary changes in the skeleton for many millions of years. This hall is especially concerned with some of the better known records in the history of the placental mammals.

The south side of the hall illustrates the evolution of the various types of odd-toed ungulates or perissodactyls. Descended from the earliest hoofed mammals or condylarths, the perissodactyls were separated into the horses, rhinoceroses, tapirs and several now-extinct lines by the beginning of the Eocene epoch. One of the extinct groups, called titanotheres, existed only during the Eocene and Oligocene. As may be noted in the alcove beside the Third Fossil Hall entrance, they evolved in this relatively short span of time from the fox-sized *Eotitanops* to the gigantic *Brontotherium* with large, horn-like processes on its skull.

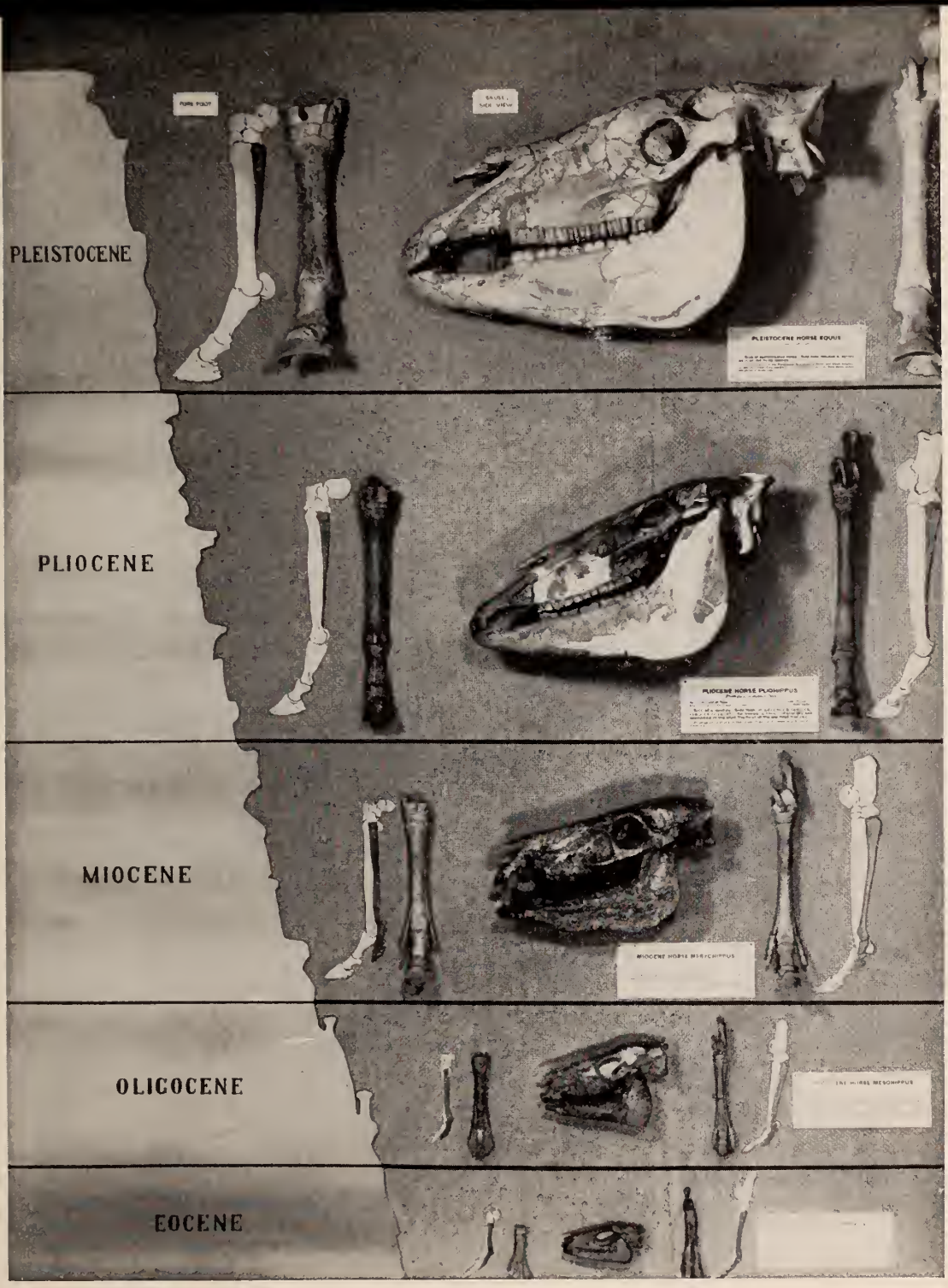
Another alcove is concerned with the extinct chalicotheres and the tapirs. *Moropus*, a skeleton of which is near the center of the hall, was a Miocene chalicothere. It had a long neck, shorter hind than front legs, and, most curious of all, claws instead of hoofs. A synoptic family tree of the perissodactyls is exhibited at the back of this alcove.

The rhinoceroses had a complicated fossil history and several distinct lines were evolved. *Hyrachyus* and *Hyracodon*, in the adjacent alcove, are examples of slimly built Eocene and Oligocene running rhinoceroses. *Amynodon* and particularly *Metamynodon*, represented by complete skeletons in separate cases, were short-legged, hippopotamus-like forms. *Trigonias* and *Teleoceras*, also in individual cases, were close to the ancestry of the living rhinoceroses. The large block of *Diceratherium* bones, including the skulls of twenty-one individuals, gives some conception of the enormous number of these animals that lived in Nebraska during the Miocene period.

The history of the horses has long been of interest to students of evolution. The changes that occurred between the early Eocene *Hyracotherium-eohippus* and the modern horse can be traced with great exactness because of the excellence of the horse fossil record. A series of progressively later horses demonstrates the reduction in the number of toes to the single functional toe of the modern forms. The lengthening of the limbs and the skull and the increase in general body size are well demonstrated.

Across the hall several alcoves are devoted to the many and varied even-toed ungulates or artiodactyls. The family tree of the artiodactyls shows the relationships of certain living members of the group (which includes the pigs, peccaries. hippopotami, camels, deer, giraffes, antelopes and cattle), and a few of the many fossil families. The artiodactyls, like the perissodactyls, evolved from the condylarths.

Perhaps the most successful artiodactyls of the Middle Tertiary in



Evolution of the Horse. *The important changes from the Eocene eohippus to the modern horse are illustrated here by the skull and feet. Changes can be traced because of the excellence of the fossil record. The history of the horses has long been of interest to students of evolution.*

A Group of Miocene Camel Skeletons (Stenomylus). *Some of these are mounted in characteristic attitudes as if living, others are lying on the rock matrix as their remains were found by a Museum expedition.*

North America were the oreodonts. These rather pig-like ruminants were very abundant, particularly in the Oligocene and Miocene periods. The agriochoerids, represented by the skeleton of *Agriochoerus*, resembled the oreodonts except that the feet bore claws rather than hoofs.

The pigs of the Old World and the living peccaries of the New World had a long separate history. Skulls of typical examples of each group are shown.

Stenomylus was a small Miocene camel that lived in North America. The group in the center aisle is made up of skeletons of this creature as they were preserved in the rock, and in various living poses. The early evolution of the camels occurred in North America, and they did not enter South America (llamas) or Asia until near the end of the Age of Mammals.

The display of flesh-eating mammals or carnivores includes fossil representatives of the various types of cats, including the saber-tooth forms, and

Mammals of the Upper Pliocene in Arizona. *In the foreground is the single-toed horse Plesippus. The background shows camels and mastodons in the distance.*

also the mustelids, bears, raccoons and dogs.

The rodents — squirrels, beavers, rats and mice, porcupines and guinea pigs and a host of other living and extinct forms — are the most successful and numerous of living mammals. The various types of fossil rodents known from the Eocene and Oligocene periods indicate that this group was subdivided into many evolutionary lines early in the Age of Mammals. The rather squirrel-like *Paramys* was a typical early rodent.

Ice Age Mammals

The Pleistocene, or Ice-age, is one of the most interesting geological periods because it was during this comparatively short span of time that most of the evolution of man took place. The animals which lived then, sharing with early man the rigors of a glacial climate, were the most immediate ancestors of those we know today. In the Osborn Hall of the Age of Man are displayed many of the animals which are known to have been contemporaneous with early man. The murals on the walls, painted by Charles R. Knight, show groups of Pleistocene mammals of North and South America and Europe, and some of the early men associated with them.

Among the most spectacular of Pleistocene animals were the mastodons and mammoths, relatives of the modern elephants, remains of which are widely distributed over the earth. The evolution of these two distinct groups of the Proboscidea is shown here, beginning with the most primitive mastodons, on the right as the hall is entered from the elevators. These, the moeritheres, found in Egypt, were the smallest proboscideans, and had both upper and lower tusks and a short trunk or proboscis. Specimens in succeeding cases, from many parts of the world, show the gradual reduction of the lower tusks and number of teeth, the shortening of the front of the skull as the trunk lengthened, and the increase in size and bulk of the animal.

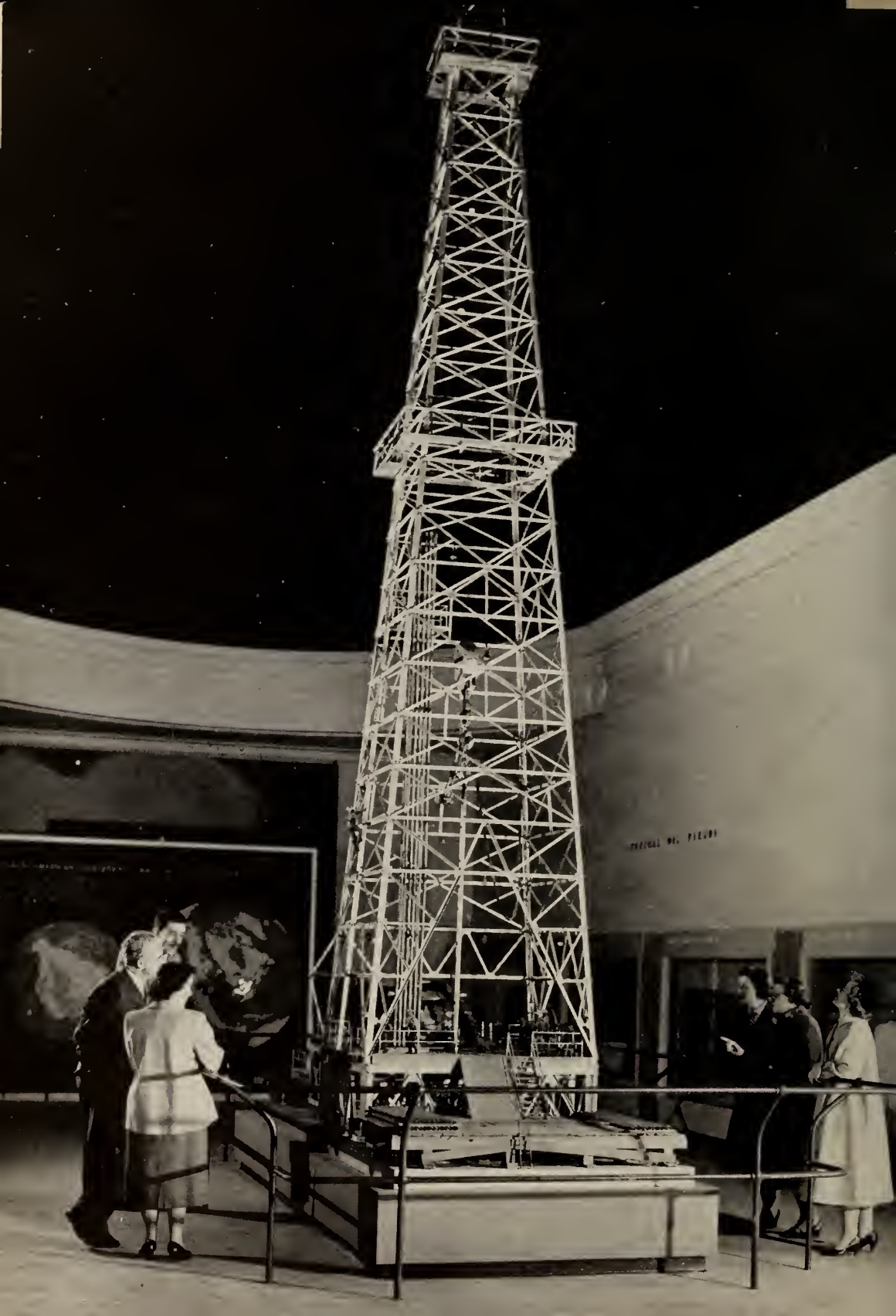
Three special exhibits, illustrated by skulls and jaws from the magnificent collections of Mr. Childs Frick, show (1), three widely different mastodon groups, based on the character of lower jaws and incisors; (2), the remarkable variation and specialization of the lower jaw symphysis and incisor

within the so-called "longirostrine" group of mastodons; and (3), a life reconstruction on one side of a fossil skull and jaws of one of the longirostrines, *Ocalientinus*, showing the external appearance of the animal's head, cross-section of muscle and hide, and the bone itself.

Three mounted skeletons represent various stages in the evolution of the mastodon group: *Trilophodon*, from the lower Pliocene of Texas, is considerably larger than the moeritheres, but retains primitive features such as the elongated lower jaw and small lower tusks. *Megabelodon*, another long-jawed Pliocene mastodon, is not an ancestor of either the true mastodons or of the mammoths and elephants, but belongs to a distinct group of proboscideans. The skeleton which represents the American mastodon is here called "The Warren Mastodon," because of its interesting history. One of the most perfectly preserved fossil skeletons ever found, it was collected in 1845 from shell-marl beds on a farm near Newburgh, New York. After exhibition in New York and New England, it was purchased by Dr. John Collins Warren, a professor of anatomy at Harvard College, was mounted in 1846 and seen by thousands of visitors. In 1849 it was remounted and placed on exhibition in the Warren Museum in Boston, where it remained until 1906, when J. Pierpont Morgan presented it, with the entire Warren Collection, to this museum. In 1907 the skeleton was taken apart, cleaned

Restoration of Rancho La Brea Tar Pool Scene. *This painting includes the giant condor, saber-tooth cat, giant ground sloth, the Imperial Mammoth and the dire wolf.*

Woolly Mammoth. *A herd of the woolly mammoths, showing their long curving tusks and shaggy coats, along the banks of the River Somme, France, during the last glacial stage.*



and remounted as it stands today. The American mastodon was the most abundant of the Pleistocene proboscideans of North America, especially in the forested regions east of the Mississippi.

The tall Columbian mammoth skeleton, with its great incurved tusks, is a dramatic example of the group of true elephants which co-existed with the mastodons in Pleistocene times. Mammoth skulls and jaws from many parts of the world, and one of the largest known mammoth tusks, over 16 feet in length, are exhibited here, with skulls of the living Indian and African elephants for comparison. Many remains of Pleistocene mammals have been discovered in the frozen ground of the far north, often with flesh and hide well preserved. Examples of the dried flesh, wool and hair of a woolly mammoth found in Alaska may be seen here.

On the same side of the hall is a group showing how animals were trapped in natural asphalt pools at the famous Rancho la Brea tar pits in Los Angeles, California. Additional mounted skeletons of the saber-tooth tiger and the wolf are displayed nearby. Here also is the huge European cave-bear, mounted in a standing attitude of attack. Pleistocene artiodactyls, or "even-toed" ungulates, include a series of skulls of various kinds of wild cattle and a mounted skeleton of a bison from Folsom, New Mexico, showing the association of arrow-points with bones of this animal. The mounted skeleton of the Irish deer, *Megaloceros*, with its wide antlers, is historically interesting in being the first mounted fossil skeleton exhibited in this museum. In contrast to this, is the skeleton of a pigmy hippopotamus which lived in Madagascar during Pleistocene times.

A small group showing one way in which fossil bones are preserved is the reproduction of part of the Conard Fissure locality in the Ozark Hills of northern Arkansas. During Pleistocene times, a fissure, or open crack caused by earth movements, was gradually filled with rocks, red clay and stalactites. Imbedded in this are found the bones of animals which inhabited the fissure, and of the prey they dragged into it. More than 60 different species of mammals, birds and reptiles have been found, mostly of a forest fauna such as bears, wild-cat, wolves, rodents, bats and snakes.

MICROPALEONTOLOGY

Micropaleontology is that phase of general paleontology that deals with very small animals and plants. The Department of Micropaleontology is wholly a research department and has no exhibits except for the models of *Foraminifera* displayed in the gallery of the Hall of Ocean Life and in the Hall of Petroleum Geology. The latter exhibit shows the use of microfossils in oil finding.

The work of the Department includes research on the literature of the field, research on fossil material on a contract basis, and independent work on microfossils. Studies are also carried on to determine the relationship of fossil and living forms to their past and present environments.

Oil Derrick Model, Oil Geology Hall

The results of these studies are largely contained in published material distributed to subscribing members of the Department. Among those subscribers are almost all of the larger universities and colleges, other museums and research institutions, and all the major oil companies of the world, whose search for oil utilizes the information derived from both plant and animal microfossils.

Hall of Oil Geology

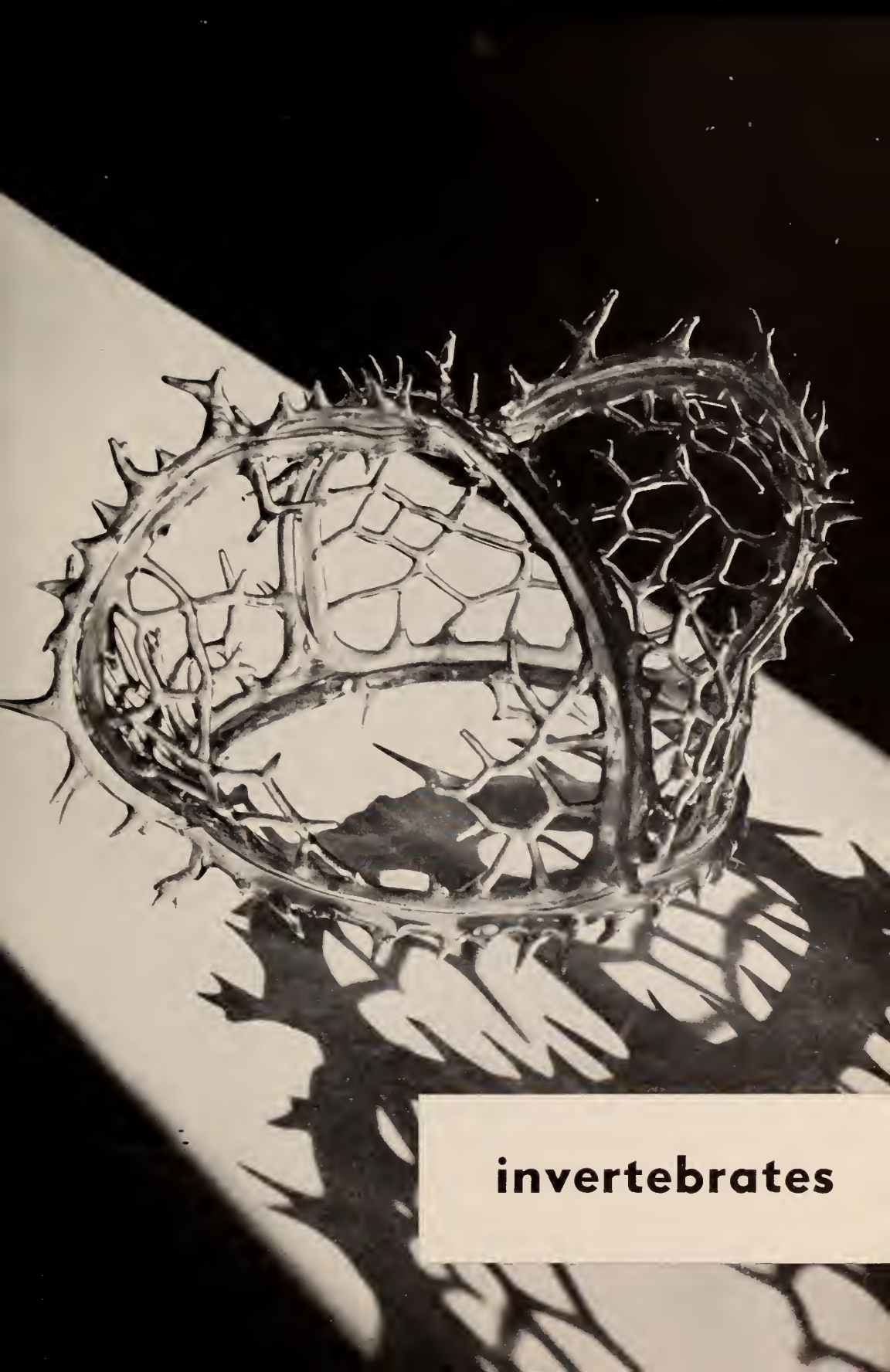
In collaboration with the Standard Oil Company (New Jersey) the Museum has completed a comprehensive exhibit of the natural history of petroleum in Hall Number 1 on the Second Floor. One of the most comprehensive exhibits of its kind, the Hall explains how petroleum, oil from the earth, is one of our most valuable natural resources. In a few short years it has revolutionized our mode of life. With the perfection of the automobile, the airplane, the diesel engine, and the oil furnace, we have passed from the age of steam to the age of petroleum.

This Hall tells the story of oil: the formation of oil by plants and animals during the millions of years of earth history; the ingenious geological methods that have been devised in a search for the increasingly hard to find oil deposits; the methods of extracting oil from the ground, and a growing need for new supplies of oil which makes modern life possible.

The exhibits are arranged in logical sequence starting at the southern entrance to the Hall near the 77th Street elevator, passing to the right in a counter clockwise direction. The subject is introduced with an explanation of the origin of petroleum, how it accumulates within the pores of sedimentary rocks, and how it becomes concentrated in sufficient quantities to be economically valuable. Elementary geological principles that control the formation and localization of oil accumulations are discussed and illustrated briefly and a number of typical oil fields are represented by scale model dioramas which show the underground conditions responsible for the oil fields. The influence of geologic time on the formation and distribution of petroleum is explained in one exhibit and another illustrates the importance of paleontology in the search for oil. Geological and geophysical methods of prospecting for oil fields are graphically shown and a series of displays containing models and actual instruments and drilling tools lead the visitor through the successive steps in location, drilling, and completion of an oil well. A number of diagrams, graphs, and charts show that American standards of living are intimately associated with the availability of enormous quantities of cheap petroleum.

The entire exhibit is dominated by a twenty-five foot scale model oil derrick in the center of the Hall. Below the derrick the rotary table is in motion simulating actual drilling of a well. Realistic sound effects are provided by a tape recording of drilling operations.

Careful study of the exhibits in this Hall will provide a comprehensive and accurate understanding of oil geology.



invertebrates

invertebrates

The exhibits include a number of habitat groups showing invertebrates in their natural surroundings and a synoptic series from the simplest single-cell animals to the most complex invertebrates.

THE SYNOPTIC SERIES

Because of the small size and fragile nature of many invertebrates, a large part of this exhibit consists of glass or wax models, often much enlarged. These include the famous jewel-like creations of Herman Mueller.

One-Celled Animals — *Protozoa.* These exhibits show the simplest form of animal life. Although in some forms the animals assemble into colonies, all are single-celled individuals. These exhibits are mainly models which represent protozoa enlarged hundreds of times.

Sponges — *Porifera.* Sponges are made up of many cells but these are comparatively loosely organized and do not form definite and distinct tissues as in the higher animals. Sponges range in size from small incrustations on stones and shells to the gigantic Neptune Goblets of Eastern Seas.

Stinging Animals — *Coelenterates.* These include the coral animals and their relatives, the hydroids, jellyfish, sea anemones, sea fans, sea plumes,

stony corals and similar creatures. The stinging animals have their cells organized into definite tissues but these do not form real organ systems as in the higher forms.

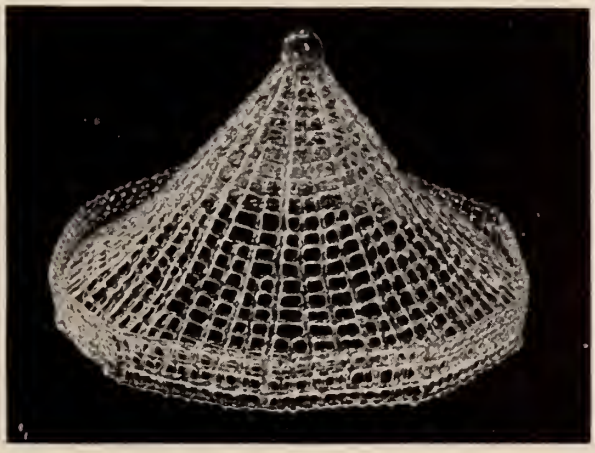
Comb Jellies — *Ctenophora.* While similar in appearance to the stinging animals, these lack the stinging cells characteristic of the last group. Although they do not have definite organ systems, their organization is more complex than that of stinging animals. Transparent with iridescent, vibrating, swimming hairs, in life they are often objects of great beauty.

Flat Worms — *Platyhelminthes.* There are many important parasitic species of flatworms, including the tapeworm, which are shown in a series of models. The enlarged wax models of free-living forms show mostly species from the Mediterranean, but beautifully colored flatworms are found in almost all seas; those living in fresh water are usually less brilliant. All of the important organ systems of the higher animals are present in these worms.

Roundworms — *Nemathelminthes.* The parasitic roundworms are very widespread; almost every other type of many-celled plants and animals harbour one or more species of nematodes. Several serious human diseases such as trichinosis and elephantiasis are caused by these animals. Less well-known are the vast numbers of free-living nematodes found nearly everywhere in the soil and in both fresh and salt water.

Rotifers — *Rotifera.* The minute wheel animals or rotifers include many exquisite or grotesque forms. A few are parasitic but most are free-living. Most of them live in fresh water where they are very widely distributed. In addition to the comparative series of models of enlarged rotifers in the wall case at the southwest end of the gallery, rotifers in their natural environment are shown in the Pond Life Group at the other side of the Bahama Reef Group.

Spiny Animals — *Echinodermata.* These include the sea stars, brittle stars, sea urchins, sea cucumbers and sea lilies. In spite of their entirely



Sethophormis. *This glass model shows the silica skeleton of a typical Radiolaria. These minute animals live in the deeper water of the seas.*

Chambered Nautilus. *A cross section showing the chambers. The animal occupies the last chamber.*

different appearance, many zoologists believe that this group of invertebrates is that which is most closely related to the chordates, the group of animals to which man belongs. This conclusion is based upon a study of the body chemistry and of the early stages in their life history.

Chordates — *Chordata.* The phylum includes not only the vertebrates but a number of small, relatively primitive and unfamiliar animals as well. The three cases devoted to this phylum in the Gallery of Living Invertebrates show the hemichordata and the ascidians. Anatomical models of important members of these groups show the details of their internal anatomy while other exhibits show the external appearance of many other forms.

Proboscis Worms — *Sipunculoidea and Echiuroidea.* These small groups of worm-like animals have until recently been included either in the segmented worms or combined into one group, the Gephyrea. Their anatomical peculiarities are, however, sufficiently distinct to justify considering them as separate groups. They are all marine and for the most part live either in burrows or in natural fissures.

Segmented Worms — *Annulata.* As typified by the common earthworm, these worms are made up of rings or segments. They include many remarkable and beautiful marine worms as well as the more familiar earthworms and leeches.

Joint-Legged Animals — *Arthropoda.* These include the crabs, lobsters, insects, spiders and their relatives. The number of living species in this group is greater than that of all the rest of the animal kingdom. The lobster exhibited here is one of the largest ever taken. The largest living arthropod is the Giant Japanese Spider Crab which is shown in the case at the north end of the gallery.

Mollusks — *Mollusca.* The mollusca are next to the arthropods in the diversity and number of forms. They include clams, snails, slugs and limpets

A Portion of the Bahamian Reef Group. *Coral is a colony of animals that secrete a limey skeleton.*

as well as squids and octopuses. All these animals have soft bodies but most of them secrete a hard exterior shell. The wall cases at the north end of the gallery contain a series of mollusk shells selected to show the range of size and form in each of the superfamilies. In the "A" case near the entrance to the hall are a group of large shells including a paper nautilus which is believed to be the largest perfect specimen.

Upon entering the hall, a large model of the ***Giant Squid,*** *Architeuthis princeps* is seen overhead. This model is based upon the studies made by Professor Verrill on specimens stranded in Newfoundland between 1872 and 1879. These large animals are attacked and eaten by the sperm whales. A fight between these two monsters of the sea is shown on the right in a mural painted by J. M. Guerry.

HABITAT GROUPS

On both sides of the hall at the far end of the gallery are displays showing invertebrates in their natural habitats. ***The Salt Marsh Group*** is the first on the left. This group depicts the life in a salt marsh at Cold Spring Harbor, Long Island, and is typical of such marshes from Cape Cod to Cape Hatteras.

The Sound Bottom Group represents a sandy bottom with large granite boulders forming the reef known as the Devil's Bridge in Vineyard Sound, Massachusetts. The lobster and blue crab are among the animals shown.

The Wharf Pile Group includes animals living in and among the submerged piles of an old wharf at Vineyard Haven, Massachusetts. The piles are covered with the flower-like colonies of sea anemones, hydroids and other stationary animals.

The Pond Life Group, photo page 87, displays a cubic half inch of pond bottom enlarged one hundred diameters or cubically a million times, transforming a minute area into a forest peopled by rotifers and other strange creatures ordinarily invisible to the naked eye.

On the other side of the upper part of the Bahamian Reef Group a companion exhibit to the Pond Life Group shows two square inches of sea bottom enlarged to an area five feet square. Pieces of sea weed are seen encrusted with colonies of Bryozoa composed of thousands of small animals each of which has built a vase-like shell. Encrusting ascidians and their tadpole-like young, a sea spider and flower-like sea worms are among the other strange animals found here.

The Rock Pool Group contains the life which may be found in rock pools along our shores north of Cape Cod. In the scene, the falling tide has left a pool in a rocky basin which shelters a community of sea anemones, sea stars and other invertebrates.

The Eelgrass Group shows a portion of the bottom of the harbor at Woods Hole, Massachusetts. In addition to the animals living on or above the bottom, a cross-section of the bottom reveals animals which burrow into the mud and sand.

The Bahamian Reef Group, photo page 89, is seen at the farther end as you enter the Hall of Ocean Life. The portion of the group above the gallery shows the coral island and quiet lagoon. On the distant horizon the low-lying Bahama Island of Andros is seen with its fringe of coconut palms. Here the finest barrier reef in the West Indies parallels the shore. The small island in the foreground below the gallery depicts the coral forest as seen from the bottom of the sea. Many colorful inhabitants of the reef are seen among the branches of the tree-like elkhorn coral which rise to the water surface sixteen feet above.

The Pearl Divers Group to the right of the Bahamian Reef Group represents a scene on the ocean floor within the enclosed lagoon of the coral atoll, Tongareva. This small, ring-shaped island, eleven miles in diameter, is in the South Pacific Ocean about 2000 miles south of Honolulu. This group shows the marked contrast between the brilliantly colored delicate ponds and finely divided clusters of coral found in the Pacific reef and the weird, branching species of the Atlantic exhibited in the adjoining Bahamian Reef Group.

insects and spiders

insects and spiders

Insects and spiders play a very important part in man's every day life, a part which is too often ignored or about which too little is understood by the general public. About 80% of the total number of species in the Animal Kingdom belong in the phylum Arthropoda which includes insects and spiders. At the present time approximately 850,000 species of insects and spiders have been described, and it is probable that there exists the almost unbelievable number of 9,000,000 additional species. Many insects and spiders have no direct bearing on man's economy or interests although they may be very important in maintaining a balance in nature. Because of this large number of species, it is, therefore, impossible to display examples of each.

In the Insect and Spider Hall, which is the largest and most complete exhibit of its kind in this country, examples of some of the more interesting species, and ecological and biological phenomena are presented. Beneficial and destructive insects are displayed, along with beautiful and bizarre insects from all over the world. These exhibits have been accomplished through the efforts of the research staff of the Department of Insects and Spiders, which is constantly studying many phases of insect and spider life. Problems in biology and ecology are always attracting the staff to work

afield in many areas in this country and abroad where large and important collections are made.

Much of the work carried on in the laboratories at the Museum has to do with the classification or naming of the various species. The importance and necessity of this research work to the public arises from the fact that each year we receive thousands of requests for identifications of insects and spiders that have come to the public's attention. We are constantly being asked to name a particular insect and to state whether or not it is dangerous, if it will destroy household furnishings, the home, personal belongings, or if it will affect the health of individuals coming in contact with it.

The visitor's interest in the Insect and Spider Hall will be affected by his own personal experience. The suburban dweller will perhaps be more interested in those insects affecting garden or ornamental plants, whereas the apartment house dweller who has no garden will probably be more interested in household insects. Exhibits of insects of interest to both groups are to be found in the Insect and Spider Hall.

Through the ages and even before the time of civilization, man has struggled with the insects for his existence. At the same time many insects contribute beneficially in supplying man with various commodities and many predaceous and parasitic species have aided in the control of destructive insects. The ways in which insects are beneficial to man are many and varied. Among these we might mention the silk worm in relation to true silk of commerce. Beeswax and honey are products of the honeybee which have long been used by man. Shellac is a secretion of a scale insect of India. The cochineal scale insect is used as a dye for artificial coloring of foods, drinks and cosmetics. A number of extracts of medicinal value have been made from the bodies of insects, and spider silk is employed in the manufacture of certain optical instruments. These are but a few of the examples of direct usage of insects. Probably the most important benefit derived from them is in their pollinizing of various fruits, seeds and vegetables which form a large portion of man's diet. Most of the animals used by man for his meat are dependent upon plants which would not exist if this pollinization were to cease. Even many of the fish products utilized by man would disappear were it not for the fact that aquatic insects are available as food for the fish. Many of our game birds are dependent almost entirely, or at least in large part, on insects for their food. In many parts of the world, from ancient times to the present day, insects have been eaten by human beings. Among these we might mention grasshoppers, crickets, beetles, caterpillars of moths and butterflies, termites and aquatic flies and bugs. Insects have also been used extensively in scientific research on genetics, physiology, psychology and sociology.

The ways in which insects are injurious to man are many and often of a critical nature. They injure or kill all kinds of crops, forest trees and valuable plants by chewing the foliage, sucking the sap, boring or tunneling

The Human Flea. *Relatives of this flea are responsible for the transmission of Bubonic Plague, still a scourge.*

into roots, stems or leaves, by carrying organisms such as fungi, bacteria, or protozoa which then attack the plant. It has been estimated that the direct annual agricultural losses occasioned by insects in the United States are about $2,000,000,000. They attack and annoy or kill living animals. Many species such as flies do direct damage by feeding on living tissue, others carry parasites of various diseases, some serve as intermediate hosts for organisms pathogenic to man and still others are venomous and are capable of causing bodily injury.

The species most commonly observed by the public are those which attack stored food products, clothing, books, furniture and buildings. Termites are among the most destructive in this group but such insects as powder post beetles and cigarette beetles do considerable damage to furnishings. The clothes moths and the carpet beetles do millions of dollars in damage annually to clothing and similar materials. The meal worms are often found in packaged cereals and other prepared grain foods and make such products unfit for human consumption. To this group can be added a host of species which attack field crops and upon which we are constantly required to apply expensive control measures. Among these pests we might mention the Colorado potato beetle, the Mexican bean beetle, the cotton boll weevil and the corn ear worm. No part of a plant is immune to insect attack. The immature stages of many species feed on the roots, whereas both immature and adult insects attack the leaves, stems, fruits and flowers.

Some of the greatest scourges in the history of mankind have been transmitted by insects. Black Death or Plague, which is transmitted by a flea, has claimed millions of lives since the sixth century and continues to be a constant menace to modern society. Yellow fever transmitted by the mosquito has at times made portions of the world uninhabitable and nearly prevented the construction of the Panama Canal. Malaria, also transmitted by the

mosquito, has been and is an important disease of man. It is widely distributed throughout the world and during the recent war a considerable number of men had to be employed in the control and prevention of this disease. Typhus, transmitted by the body louse, has always been a major problem in congested areas and many thousands of people in many parts of the world suffer from its depredations. Ticks and mites, which are not insects but are related, carry a number of diseases which are of great importance. Rocky Mountain spotted fever which has claimed the lives of many people is carried by a tick. A number of species of mites are responsible for mange and almost everyone has come in contact with the red mites which make life miserable over extensive areas in the New World.

From the above account the reader will be impressed by the fact that very few organisms or habitats on the earth's surface are not frequented by insects. Indeed they have been more successful in adapting themselves to life on this world of ours than any other organism. Proof of this adaptability can be seen when one considers that insects came into being some 300,000,000 years ago and have out-lived such animals as the dinosaurs which might seem to have been better able to survive because of their size and strength.

THE EXHIBITS

The Museum visitor often wonders about the relationships between various groups of organisms. The Animal Kingdom is divided into a number of very large groups called Phyla. The insects, spiders and mites belong to the phylum Arthropoda. This phylum contains a number of classes including the Arachnida, or spiders and mites, and Insecta, or insects. In other words, the two groups belong to the same phylum but to two different classes within the phylum. The Insect and Spider Hall, therefore, covers members of two classes belonging to the phylum Arthropoda. Exhibits showing other classes in this phylum are presented in other halls in the Museum.

Beneficial Insects. Many insects and insect products have been and are utilized directly or indirectly by man. In Case 9 examples of the swarming of honeybees as well as the various types of cells contained in the hives are presented. Illustrations of the worker and queen and drone bees are also shown. Included in this exhibit is an example of the bee moth whose larva feeds at night on the wax of the combs.

The Bee. *While looking for food for young bees, the bee picks up pollen on its hind legs, some falling on flower pistils.*

Model of Mole Cricket *(enlarged five diameters). The mole cricket has curiously enlarged front legs, which are used in excavating its burrow; the hind femora are slender. It is seldom seen above ground except at the mating season.*

Many different kinds of insects are used for fish bait and others are used as models for the construction of fishermen's "flies." Case 24 contains a series of models showing how to tie a fly, together with models of well-known commercial flies now in use. Examples of both American and English fishing flies are shown.

In Case 2 various examples of fruits, vegetables and other products whose development is dependent upon insects for pollination are presented.

A very extensive exhibit on the progressive stages in silk culture is shown in wall cases. This traces the development from the larval stage of the silk moth through the various stages in the manufacture of silk to the finished product. Examples of the adult silk moths and related moths with their pupal cases are also given.

Destructive Insects. On the south side of the hall in a number of cases are a series of exhibits showing insects that attack various types of plants and food products that are of value to man. Actual specimens and examples of types of injury are included. Such household pests as clothes moths, carpet beetles, cockroaches, house ants and bedbugs are presented either as actual specimens, or, where the insects are very small, as enlarged models or illustrations. Pests of stored food products including the flour moths, meal worms and tobacco beetles are to be found in these groups. Other insects attacking cotton, truck crops, fruits, woody plants, shade trees, nut trees and coniferous plants are to be found in this series. This is an important exhibit since the ravages of insects cost the nation much yearly.

Many amateur observers mistake the termite for the ant in attempting to identify them. One of the most destructive and most commonly encountered of the household insects is the termite. In Case 25 the visitor will find enlarged models showing the differences between the termite and the ant and in Case 4 a diagrammatic chart of the life history of the termite. Also in this case the visitor will find a series of enlarged models showing the various castes in the termite's social organization.

Insect Biology and Ecology. The life history, habits of ants and their relation with other insects are presented by a series of illustrations and photographs in Case 3.

In Case 12, by means of colored illustrations and actual specimens, the growth and development of the Io moth is shown. Also in this case the visitor will find the immature stages and adults of the 17-year locust.

Case 13 is a habitat group in which the Mole Cricket is shown in its natural environment in the ground.

Similarly in Case 14 a dragonfly nymph is shown in the act of catching a mosquito larva. Both of these exhibits depict the insects enlarged five times natural size.

Habitat group No. 21 shows a portion of a colony of Army ants with raiders bringing back insects they have captured and killed.

Case 22 is a similar exhibit showing leaf-cutting ants on branches, entering the nests, carrying the pieces of leaves that they have cut. These pieces of leaves are not eaten but are used in growing a special kind of fungus that is eaten as food.

Habitat group No. 23 shows a nest of the stingless bees with the entrance extending from a cavity in a tree. These bees are unable to sting and the

Dragon-Fly Nymph *catching a mosquito larva by means of its curiously modified lower lip which is segmented and has a pair of pincers at its tip. When not in use, it is carried folded back like a mask, shooting forward like a flash when needed, should unwary prey come into view.*

honey of some species is pleasant to the human taste and is utilized by the inhabitants of many tropical countries.

An example of beetles in hibernation is presented in Case 20, showing the massing of Lady Bird beetles in a mountainous area.

The abundance of, and destruction caused by, the Japanese beetle is illustrated in Case 19.

Insect and Spider Architecture. Case 5, although incomplete, contains a number of examples of the different types of nests constructed by various species of tropical wasps.

Various types of ant nests are shown in Case 3.

In wall case No. 1 are models showing the processes in the weaving of the spider web. Pictures of actual webs, with colored illustrations of the spiders, are also to be found in this group.

Beauty in the Insect World. There is probably no group of organisms on the earth's surface in which can be found the combination, variety and brilliance of colors shown by insects. Case 15 presents many of the more beautiful butterflies and moths from various sections of the world. These are arranged around maps in which the areas of distribution represented by the moths and butterflies are variously colored.

Additional examples of many species of beautiful butterflies and moths from many parts of the world can be found in the cases surrounding the whale in the Hall of Biology of Mammals which is to the west of the Insect and Spider Hall.

Oddities in Insects. A series of enlarged models in Case 16 illustrates the peculiar structures in the treehoppers and a series of models shows the complete life cycle of a local species.

In Case 17 the visitor can see actual specimens of insects showing the differences between the males and females of various species of beetles, moths and butterflies. Actual examples are also presented showing various types of special adaptation including the very long ovipositors in some wasps, the very long mouthparts in moths and the extensive wing development in the dragonfly which makes possible its very rapid flight. The phenomenon of variation is illustrated by actual examples in three species of insects.

House-Fly *showing four stages in its life cycle: eggs, larva, pupa and adult. This insect is responsible for the transmission of typhoid fever and filth diseases.*

A Gathering of Monarch Butterflies. *In early autumn, the Monarch Butterfly assembles in great swarms in various sections of the United States. At nightfall, large numbers crowd onto the leaves and the branches of trees and shrubs. These swarms move southward for the winter much as birds migrate. The females come north the next spring and re-establish the northern population.*

Insects that mimic their environment are displayed in Case 18. Protective coloration as shown in some of the moths is presented, showing these insects in a portion of their actual environment. This exhibit also includes species that resemble dead twigs or leaves and others that look like fungus growths on tree trunks. A number of examples of mimicry — instances in which insects, commonly eaten by other organisms, resemble species that

are not eaten and are probably distasteful — are presented. This case also includes a series of bizarre species. An example of a walking stick, one of the longest of all insects known, is on display with its wings extended. Various types of leg, antennal and mouthpart developments in beetles are shown by actual specimens.

Insects and Diseases of Man. It has been estimated that the annual vital loss to man and his domestic animals attributed to insects or diseases carried by insects is about $781,450,000. One of the most important diseases in the Western Hemisphere is malaria carried by the mosquito shown in exhibit No. 6. Shown are enlarged models of the egg, the egg raft, the larvae, the pupae and the adult and also a cross-section showing the internal anatomy of the adult. Descriptions of the various stages and comparisons with other species are given on the labels and by means of various diagrams.

Another disease that has been the scourge of mankind is yellow fever and the mosquito that is responsible for its transmission is shown in Case 7.

Typhus is a very important disease in congested areas and during war time, and is transmitted by the body louse which is exhibited as an enlarged model in Case 7. The carrier of Plague or Black Death, a flea, is also presented as a model in this same group. Everyone has come into contact at one time or another with the common house-fly. This insect, although primarily a food contaminator, is also a carrier of filth diseases and typhoid fever. Enlarged models in Case 7 show the eggs, larva, pupa and adult. Most of the models shown in Cases 6 and 7 are enlarged 74 diameters or 400,000 times the volume of the actual specimens.

Case 8 contains actual specimens and enlarged colored paintings of the tick which carries Rocky Mountain spotted fever, a bug that carries Chagas disease, and the flies that are responsible for African sleeping sickness, Tularaemia and Filariasis.

On the first floor Roosevelt entrance, in the section dealing with New York State exhibits, the visitor will find on the south wall in the corridor some examples of the butterflies and moths of New York State. These are actual specimens and beneath each is the correct name. Several of the species also have their immature stages illustrated in color. The viewer should remember that this is not a complete collection of the butterflies and moths of New York State although most of the common species are represented.

It is hoped that those individuals who have occasion to visit the insect and spider exhibits will find them stimulating and that they will be encouraged to make their own observations. Insects and spiders are so abundant in nature that it is not difficult for the average individual to find many interesting problems within his immediate surroundings. Many important observations on insect behavior and biology have yet to be made and important discoveries can be forthcoming from the careful amateur observer. We hope the insect hall serves as an introduction to many of the interesting phases of insect and spider life.


fishes

fishes

From earliest times, man has taken much of his food from the waters of the earth. The oceans, seas, lakes, ponds, rivers and streams abound in fishes and man has discovered many ingenious ways to catch them by hook, arrow, spear, net, trap and drug.

Today, we are still fishermen in the world's waters. Much of our food is taken from both salt and fresh water. We depend on fish for many raw materials as well. Much oil, fertilizer, medicine and leather are obtained from fishing. Millions of people fish for a living and millions more fish for sport and relaxation.

The scientist looks at fishes from a different viewpoint. He studies their physical structure, classifies them as to species, and finds out as much as he can about their distribution, migrations, feeding, choice of bottom, abundance, size and growth. Such information is of great value to other scientists, and at the same time is sought by educators, medical researchers, fishermen, industry and the general public.

THE EXHIBITS

On entering the Hall of Fishes from the Hall of North American Forests, one faces a group of sharks sweeping down upon a helpless logger-head

Mako Shark Group. *In this group, the Mako Shark (Isurus oxyrhynchus), caught off the island of Bimini, is shown lunging above the surface of the water to catch an escaping albacore.*

Skeleton of a Swordfish. *Showing streamlined form and speed.*

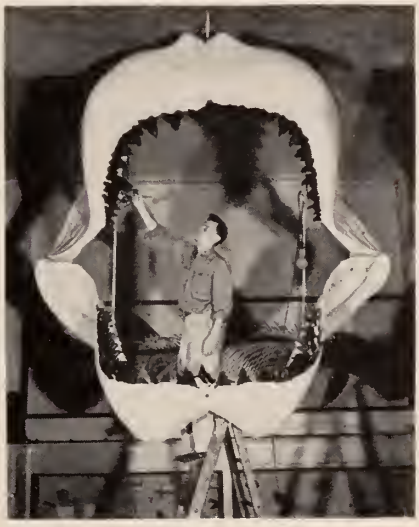
turtle. The following sharks are represented in this group: ***White Shark*** or ***Man-Eater.*** One of the largest sharks, growing to a length of 30 feet or more. This ferocious shark feeds on large fish and sea-turtles. It has been known to attack men and even small boats. Fortunately, it is apparently rare everywhere.

Spot-Fin Ground Shark or Shovelnose. May be recognized by its small second dorsal fin and very long tapering pectorals, in combination with a flattened, shovel-like nose. It produces living young, feeds chiefly on fishes and squid, and is harmless to man.

Southern Ground Shark. Somewhat resembles the Tiger Shark but differs in its very blunt snout, stouter body, very large pectoral fins and complete absence of spots. It lives in coastal waters and feeds on fishes. It is common about wharves, where it picks up refuse. It is not dangerous to man.

Tiger Shark. This fish sometimes reaches a length of 30 feet and is a very active predatory shark. It has wide jaws and powerful sickle-shaped teeth. It preys on large sea-turtles, other sharks, fishes and invertebrates. The Tiger Shark is much dreaded in the West Indies, but there are no authentic records of attacks on humans.

Fossil Shark Jaws. *This shark lived some thirty million years ago. The restored jaws are modeled after those of a living relative and they support the actual fossil teeth.*



The Sea Rovers. *An undersea scene showing a number of sharks attacking a sea turtle. This group demonstrates the pack-hunting habits of various sharks.*

Hammer-Head Shark. This shark is characterized by a grotesque elongation of its eye stalks. It occasionally reaches a length of 12 feet.

Sand Shark. This shark lives chiefly on small fishes which it captures in great numbers.

The Systematic Exhibit includes a representative series of fishes, from the lowly "cartilage fishes," such as the sharks and rays, to the highest or most complexly constructed bony fishes. Noteworthy in this series are the mounted groups of "ganoids," including the sturgeons, spoonbills, bony gars and bowfins. In the alcoves and wall cases to the right, the visitor finds many curious forms, such as the giant catfishes, the handsome rooster fish, the brilliant parrot fish and butterfly fishes.

On the left side of the ***Sea Rovers*** group is the ***Biological Exhibit.*** This considers the fish as a machine — its streamlined form, its main principles of construction, its machinery for motion, and the mechanism of its jaws.

Big Game Fishes. At the end of the Fish Hall, toward the Roosevelt Memorial, is the exhibit of Big Game Fishes, including many of great size taken with rod and line, chiefly by Michael Lerner and Zane Grey. The huge ocean sunfish, taken by Mr. Grey, weighed nearly a ton.

The central feature of the ***Sailfish Group*** is the mounted skin of a fish caught off the rocky coast of Cape San Lucas, Lower California. It is shown in the act of leaping from the water in a desperate effort to shake the hook from its jaws.

Many other fishes well known to anglers and sportsmen hang in these cases, such as salmon, trout, perch, muskellunge, barracuda, yellowjack, bonefish, and the like.

Three fine specimens of the fishes caught and presented by Michael Lerner are exhibited in special cases as if rising through the water. One is the mounted skin of a tuna *(Thunnus thynnus)* which measured 8 feet, 3 inches in length and weighed 557 pounds. It was caught on rod and reel off Wedgeport, Nova Scotia. This is the common or ***Bluefin Tuna,*** also called Tunny and Horse Mackerel. It occurs in both the Atlantic and the Pacific, and huge specimens may reach a weight of over 1,000 pounds.

The second specimen, a ***Blue Marlin*** *(Makaira nigricans ampla)*, weighed 305 pounds and measured 10 feet in length. It was caught on rod and reel off Bimini, Bahamas. ***A Mako Shark*** *(Isurus oxyrhynchus)*, also caught off Bimini, is shown lunging above the surface of the water to catch an escaping albacore.

The tuna, the swordfish, the marlin, the sailfish and the mackerel are all related, belonging to the same suborder of fishes, the Scombroidei, a group which reaches the acme of streamlined form and speed.

On the right of the exit from the Fish Hall is a large exhibit, ***The Life History of the Swordfish,*** tracing the development of the swordfish from a tiny egg to the adult.

amphibians and reptiles

amphibians and reptiles

The branch of biology that deals with the amphibians and reptiles is known as *herpetology*. In its broadest sense herpetology is concerned with the origin, evolution, distribution and classification of the amphibians and reptiles, their relationships to their environment, their life histories, their habits and behavior, and their structures and their functions. Herpetology is also concerned with the economic importance of amphibians and reptiles, and their bearing on the activities of man. The study of extinct amphibians and reptiles is more often included under paleontology.

Amphibians are backboned animals with a moist glandular skin. If scales are present they are usually hidden in the skin, and amphibians lack the protective covering of feathers or hair seen in higher vertebrates. The eggs of amphibians are usually laid in water or at least in moist places, and most of them pass through a fish-like, water-dwelling stage before metamorphosing or changing to the adult form. There are three major groups of living *Amphibia:* (1) the caecilians *(Apoda)*, superficially worm-like, limbless creatures, include burrowing as well as water-dwelling forms living in the tropics; (2) the salamanders *(Urodela)* or tailed amphibians, usually with four limbs, are largely confined to the northern hemisphere; (3) the frogs *(Anura)*, many of them popularly called "toads," are the tailless

amphibians, otherwise characterized by their relatively long hind limbs and their hopping or leaping mode of progression. The three groups of Amphibia comprise a total of approximately 2500 living species.

Amphibians were derived from lobe-finned fish ancestors well over three hundred million years ago. Some fifty million years later one amphibian stock gave rise to the reptiles. Thus the amphibians are classed above the fishes, but below the reptiles.

Reptiles are backboned animals with dry, scale-covered skins. Some reptiles give birth to their young, but most of them lay eggs, always on land. Upon emergence from the egg, the reptile is similar to its parents and equipped to obtain oxygen from the air. The major groups of reptiles include: (1) the turtles *(Testudinata);* (2) the alligators and crocodiles *(Crocodilia);* (3) the "beak-heads" *(Rhynchocephalia)* represented by a single species, the relict Tuatara, *Sphaenodon punctatum*, of New Zealand; and (4) the lizards and snakes *(Squamata)*, respectively included as subgroups of a single order owing to the existence of snake-like characters in several lizards and the retention of limb-girdles in some snakes.

Approximately 7000 kinds (species) of reptiles are still in existence, and many more passed into oblivion or are known only from their fossilized remains. The reptiles flourished at an early period of their evolution, which began well over two hundred million years ago. The original stock gave rise to such gigantic forms as some of the dinosaurs. Other stocks led independently to the warm-blooded mammals and birds. But several other stocks, including the larger "ruling reptiles," failed to survive. The modern reptiles include few species of great size; some marine turtles may reach a ton in weight and crocodiles 24 feet in length may weigh even more. The largest surviving lizard is scarcely ten feet long, but some snakes are believed to exceed thirty feet.

Unlike the birds and mammals, which produce heat internally, the amphibians and reptiles depend largely upon sources of heat outside the body. Some birds migrate to warmer climates in winter but others can remain abroad throughout the year, even in colder climates. Similarly, some mammals are continuously active, although others are forced to retire underground to avoid extremes of heat or cold. In this respect they are not unlike the reptiles, from which they differ in being heated internally while they are active.

One of the major research projects of the Department of Amphibians and Reptiles is concerned with the regulation of the body temperature in amphibians and reptiles. Investigations have disclosed the fact that many reptiles can maintain relatively high as well as fairly constant temperatures while they are abroad and active. They bask or seek out warm ground to raise the body temperature. When they become too hot they retire to shade or to shelter underground where their heat can be dissipated. Despite the fact that reptiles depend upon heat derived directly from the sun or from their surroundings, many species maintain body temperatures higher than

those of man and other mammals. Thus, while reptiles are commonly termed "cold-blooded," it has become apparent that, when active, many reptiles are quite as warm as their more advanced relatives, the birds and mammals.

It is of fundamental importance, however, that the internal heating mechanism of birds and most mammals provides them with greater freedom in their activities than the amphibians and the reptiles possess. Nevertheless, it seems manifest that many elements of the highly complicated mechanism of heat production in the mammals had their origin in the reptiles. The same portion of the brain that is sensitive to temperature changes in mammals is also heat sensitive in reptiles. Thus, by studying the origin and evolution of the mechanism of heat regulation in reptiles and the more primitive mammals, it is possible to improve our understanding of heat regulation in man, a matter of medical importance.

The Department of Amphibians and Reptiles has also carried out research projects concerned with the venom and the venom apparatus of cobras, their distributions and relationships, matters of particular importance in dealing with problems of snake bite and the therapeutic uses of venom. Similarly the Department has investigated the one family comprised of venomous lizards, the Gila monster of the United States and its Mexican allies.

Other studies by the scientific staff include those made of snake locomotion, of methods of eradicating venomous snakes, of the sense organs employed by snakes in their recognition of enemies, of tooth and fang replacement in reptiles, of homing behavior in toads, and of moisture loss in relation to habitat selection in reptiles. Many investigations have dealt with the classification of individual groups of reptiles and amphibians, or with the faunas of individual areas. Few of these projects yield results of direct economic significance. Many of them are much more concerned with the elucidation of evolutionary or distributional principles. It is of value to learn how and where amphibians or reptiles live, how they reproduce, or how they are affected by their environment, but not only because this information is intrinsically interesting. Largely it is a matter of extending the scope of human knowledge and in part it is a matter of satisfying man's curiosity concerning the unknown. For a thorough understanding of our world depends upon the assemblage and interpretation of precise information concerning all living things that surround us, and that constitute our environment in its broadest sense. And only by disregarding immediate utility in our assemblage of information is the widest utility to be served in the end.

THE EXHIBITS

The exhibits in the Hall of Living Reptiles depict representatives of all the important groups of amphibians and reptiles now surviving. As a means of furthering the scientific study of amphibians and reptiles, the Museum maintains one of the largest collections in existence. It comprises approximately 150.000 specimens and a large percentage of the species. However, scarcely 700 specimens have been used in exhibits, which display nearly

400 species, or only one out of each twenty-four that are known to science. For the individual specimens on display have been carefully selected to illustrate some peculiarity, to show some interesting attribute of the species or to illustrate a biological principle.

Upon coming into the hall from the Insect Hall to the south, the exhibits one first sees are the floor cases. These display many of the larger reptiles, the relatively gigantic crocodilians, the large land-dwelling tortoises, and fresh water turtles, and the venomous snakes of maximum-sized species, including the king cobra, longest of all venomous snakes, the two largest kinds of the rattlesnakes, and the larger of the two species of venomous lizards. Interspersed with these are smaller habitat groups showing one of the large monitor lizards, an inhabitant of the regions occupied by the Asiatic cobra and Russell's viper. Other floor groups depict the timber rattlesnake and the copperhead, the two snakes most often responsible for injuries from snake bite in the eastern portion of the United States.

At the right of the entrance leading from the Insect Hall is the splendid

Dragon Lizards of Komodo. *A male dragon lizard emerges from the dense jungle in search of food, using its long forked tongue like that of a snake to detect odoriferous particles in the air. This species still lives on East Indian Islands, particularly Komodo.*

group depicting the "dragon lizards of Komodo," the largest of living lizards, with a maximum length approaching ten feet. These great lizards, with a range confined to the East Indian Islands of Komodo, Padar, Rintja and Flores, are members of the monitor family *(Varanidae)*. This group of lizards is no longer represented in North America where it existed in pre-

Madagascar Chamaeleon. *Among lizards, only the chamaeleon projects its extremely long tongue with great speed and accuracy to catch its insect prey at a distance that may exceed the length of its body. As in the frogs, the end of the tongue is sticky.*

historic times, but it is now widely distributed in Africa, Asia and the Australian region. The exhibit shows the giant monitor in its native habitat on Komodo Island, where these lizards were collected and studied by the William Douglas Burden Expedition. The lizards were attracted by the carcasses of wild hogs, and the scene depicts a gigantic male ripping the meat from the dead animal as another lizard swallows a great chunk of meat already torn loose. A third lizard emerges from the dense undergrowth, its huge tongue thrust out as it picks up odorous particles that are carried to organs of smell in the palate, thus helping the reptile to find its food.

These huge lizards inhabit a region where there were no large carnivorous cats, wolves or similar mammals until dogs were introduced by man. Free from competition with such animals, the giant lizards became predators on the small deer, wild pigs and birds of the region, assuming the role ordinarily filled by the meat-eating mammals. The failure of the larger carnivorous mammals to reach Komodo and the adjacent islands therefore accounts for the survival of the largest lizard in these tiny islands where it remained undiscovered until 1912.

The Museum staff spends much time answering correspondence from people from all over the nation, wanting to know more about snakes. There is a vast amount of popular misinformation concerning snakes that is essentially folklore. Many erroneous notions are widely believed by other-

wise well-informed people. Snake yarns, many of them dating back at least to Aristotle, are commonly accepted even though they endow the snake with capacities bordering on the supernatural. Thus an exhibit that contrasts the snakes of folklore with snakes as they actually exist seeks to correct these mistaken beliefs. This exhibit, labelled "***Snakes of Fable and Fact,***" lies to the left of the entrance. Beyond this, along the left wall, the first of a series of exhibits in sunken panels illustrates the basic differences between amphibians and reptiles, what these animals are and why there are reasons for the belief that snakes were derived from ancestral lizard stock.

Continuing along the wall, this series of exhibits illustrates such biological principles as ***Adaptation, Natural Selection, Adaptive Radiation, Isolation*** and its evolutionary significance in the development of differences in form or habitat preference, the phenomena of ***Parallel Evolution,*** and the selective importance of ***Parental Care,*** and of ***Attracting*** or ***Frightening Devices.*** Another exhibit along the same wall explains the nature of the venom apparatus and the methods used in treating snake bite.

The corridor enclosed by the wall containing the sunken panels provides access to a series of habitat groups. These portray American reptiles and amphibians engaged in their normal activities under natural conditions. The subjects in their order from the front of the corridor are: the ***Leatherback Turtle;*** the ***Giant Salamander*** or Hellbender; the ***Bullfrog;*** a ***New England Marshland in Spring; West Indian Tree Frogs; Reptiles of the Southwest;*** the ***Galápagos Iguana;*** the ***Rhinoceros Iguana;*** and the ***Gila Monster.*** At the end of the corridor lies the ***Florida Cypress Swamp*** group.

Each of these groups emphasizes some noteworthy amphibian or reptile and its activities. The leatherback is the largest turtle in existence, with a maximum weight approaching a ton, and a wide distribution in the oceans of the world. The giant salamander, more or less strictly a stream dweller, is not the longest but probably the bulkiest amphibian in North America. It is one of the more primitive tailed amphibians, fish-like in some features of its reproduction. It is shown with its enormous eggs, laid in long bead-like strings. From his vent the male emits a cloudy substance containing the male

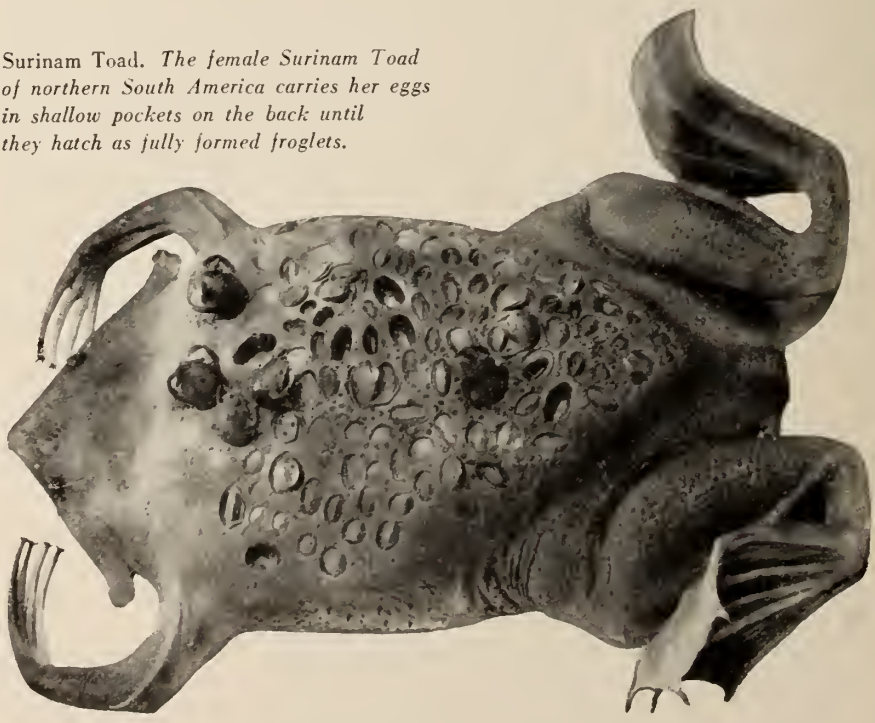
Rhinoceros Iguana. *The Rhinoceros Iguana, the most powerful lizard in the Americas, inhabits the deserts of the West Indian island of Hispaniola. Shown here are males fighting over territory.*

germ cells, which fertilizes the large eggs that he remains on hand to guard.

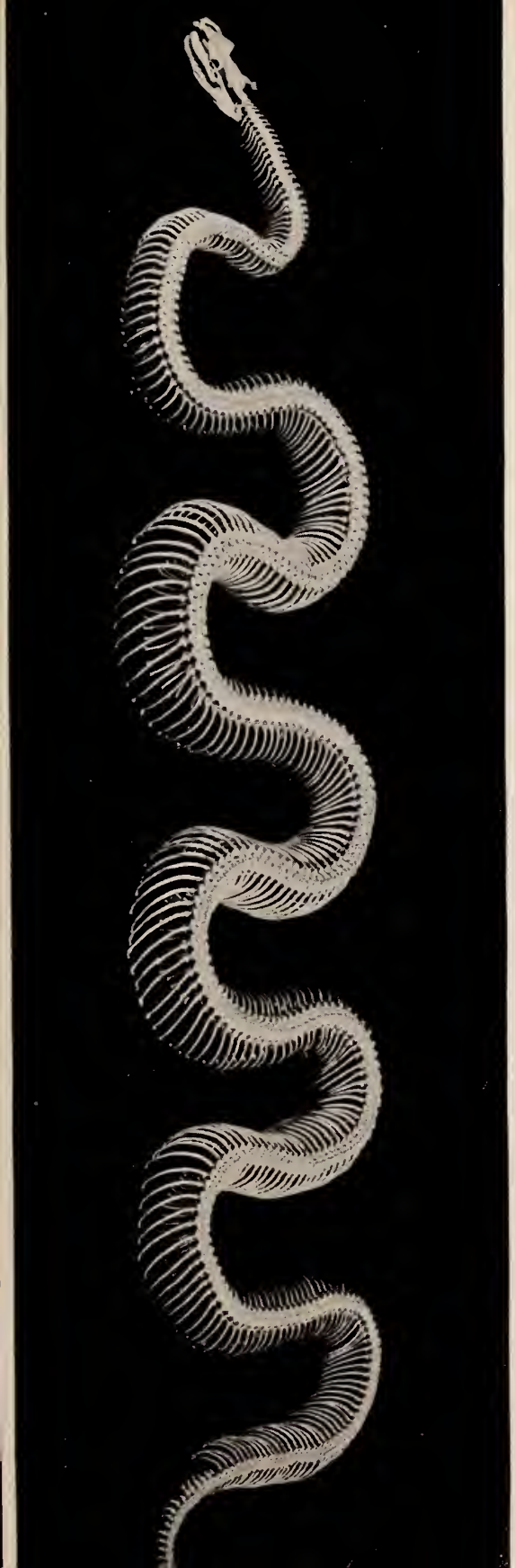
In contrast, the bullfrog in the adjacent habitat group lays its eggs in clumps on the surface of pools. It is not so securely tied to the water, for it preys upon a great variety of smaller animals on land as well as in the pools. The breeding activities of frogs are exemplified in the New England marshland exhibit, which shows male frogs and toads calling to attract mates whose eggs will be laid and fertilized in the adjacent water. Next in order is the diorama showing the activities of tree frogs, and the small lizards called geckos as they would be observed by a naturalist abroad with his flashlight during the night on a West Indian island.

Reptiles, particularly the iguanas and their relatives in the New World, thrive in arid regions. The deserts of the southwestern portions of the United States extend into the peninsula of Baja California where such bizarre reptiles as the horned lizards share their habitat with the much larger herbivorous chuckawallas. Relatives of these desert dwellers have also reached many of the islands off the coast of the Americas. In the Galápagos Islands, off the coast of Ecuador, there are two large iguanas. One is confined to the land, but the other, the marine iguana more abundantly represented in the next group, lives on the rocky shores of these volcanic islands. Unlike any other lizard, it swims offshore to feed on marine plants.

Quite unlike this marine iguana, the rhinoceros iguana of the West Indian island of Santo Domingo inhabits the extremely arid portions of



Surinam Toad. *The female Surinam Toad of northern South America carries her eggs in shallow pockets on the back until they hatch as fully formed froglets.*



Left: Skeleton of a Python. *This reticulated python (Python reticulatus) measured twenty-two feet and nine inches. The skeleton is made up of numerous vertebrae to which a pair of ribs is attached on each side. Snakes do not "walk on their ribs;" it is the muscles attached to these ribs, not the ribs, that enable the snake to move.*

Above: Pickerel Frog, New England Marshland in Spring. *In the Spring, the male frogs call to attract the females. When the eggs are fertilized, the thin gelatinous covering swells until each egg-mass is as large as a man's fist and contains thousands of eggs. Tadpoles will hatch from the eggs and change to frogs during the summer.*

the island. The group illustrates the life history of the lizard, which is sufficiently powerful to dig its own burrows in the hard fossiliferous limestone. The eggs, buried in the sand, are deposited in July. When they hatch, the young iguanas push their way to the surface, sometimes carrying portions of the egg shell with them.

Near the end of the corridor is the Gila monster group, showing the only venomous lizard in the United States in its desert surroundings. The desert tortoise and the Sonoran whipsnake, other reptiles inhabiting the same region, are not molested by the Gila monster although their eggs, as well as those of lizards, are dug from the earth and eaten. The Gila monster also devours the eggs of birds and their nestlings, and not infrequently preys on juvenile ground squirrels, and sometimes eats smaller lizards.

Exhibits outside the corridor at the end of the hall illustrate how species arise as the result of isolation on mountain tops. To the right of the exit are two groups illustrating various ways that reptiles deposit their eggs. A diagram in between explains the significant advances in reproduction represented by the reptile egg, which contains a large amount of yolk and is similar in many respects to that of the birds and the egg-laying mammals. The reptile egg allows the developing embryo to obtain its oxygen directly from the air. Moreover, it contains other structures that eliminate the need for water so that reptiles are not so restricted in their habitats as their amphibian ancestors must have been.

On the outer side of the hall there are series of reptile skeletons exemplifying the various modifications in bony structure, venomous snakes noteworthy because of their potential danger to man, and typical representatives of several main groups of amphibians and reptiles. Many of the cases on this side of the hall answer such questions as "How do reptiles and amphibians feed?" or "How do they breed?" and "What is the economic value of reptiles and amphibians?"

The Department of Amphibians and Reptiles is, as are other scientific departments, at one and the same time, a storehouse, a schoolroom, a bureau of information, a research center and a source of educational and artistic exhibits. It encompasses the activities of a secondary school as well as those of a university, for it is not only searching out new facts and reaching new conclusions from them but also presenting this information in such a manner that it can be grasped by the elementary student or by the interested layman.

Amphibians and Reptiles of the New York Region

An exhibit showing the species found within a radius of fifty miles of New York City may be seen in the corridor of the Roosevelt Memorial Wing on the first floor. It is intended especially for the use of those who want to identify amphibians or reptiles encountered in their back yards. It is of general interest in showing the number of kinds of salamanders, frogs, turtles, lizards and snakes encountered within a limited region surrounding the metropolitan area.

birds

birds

The science of bird study in all its aspects is known as ornithology. The first task of the ornithologist is to describe and name the birds of the world and to divide them into species, genera, families, and higher categories of kinship. About 8600 species are known and possibly fewer than 50 species yet remain to be discovered. There is still much to learn concerning the relationships of the families and orders of birds. New methods in systematics, as applied to populations of closely related birds, are constantly leading to a better understanding of the processes of evolution.

Migration, homing and direction-finding, the whole field of the bird's innate abilities, its "mind" and its instinctive, as distinguished from its learned responses, its genetics and adaptations are today being widely studied by critical experimental methods. Quantitative and statistical techniques have largely replaced the former modes of random observation.

As a result of its striking characters, the living bird offers a most fruitful subject for research in animal behavior. As a result of these advances, many universities today are adding trained ornithologists to their biological faculties, and modern ornithology has a respected place in the science of biology.

THE WHITNEY WING

The Whitney Wing of the Museum was a joint gift of the late Harry Payne Whitney and the City of New York. It is wholly occupied by the Museum's Department of Birds. Two of its eight floors are devoted completely or in part to public exhibits.

The Whitney Memorial Hall of South Pacific Birds

The main entrance of this wing leads into Whitney Memorial Hall, second floor, from the New York State Theodore Roosevelt Memorial. The display represents the bird life and general ecology of seventeen of the far flung islands in the Pacific Ocean, from Bering Strait in the Arctic southward beyond New Zealand and from the Galápagos Archipelago and coast of Peru westward to the Australian barrier reef and New Guinea. Here also are bronze busts of the late Messrs. William C. Whitney and Harry Payne Whitney, father and son, to whom the building and its contents are dedicated. Later generations of the Whitney family aided in the completion of the Hall. The painted backgrounds are all the work of one artist: Francis Lee Jaques.

This hall is designed to give the visitor the illusion that he is standing in the middle of the Pacific Ocean viewing scenes in every direction throughout hundreds or even thousands of miles. In short, the hall represents the entire Pacific, reduced to extremely small compass. From a common horizon linking the painted backgrounds of the habitat groups the sky appears to rise above the exhibits and the spectators' heads to the blue dome forming the ceiling of this great hall. Suspended from this "sky" by nearly invisible wires are examples of oceanic birds in flight. They represent species which are so widely distributed in the Pacific that they might be expected to visit most or all of the remote islands depicted by the exhibits.

The eighteen habitat groups, beginning at the right of the entrance, are as follows:

Ship-Followers. The view is from the deck of an old-fashioned sailing vessel in the open sea south and east of New Zealand, in the zone of the westerly winds. In the background is the Whitney South Sea Expedition schooner, the "France," which served the American Museum during ten years in Polynesia. The expedition collected many of the specimens used throughout this hall.

Pelagic birds shown in the exhibit comprise a variety of albatrosses and petrels.

Samoa. A view from the hills of the island of Savaii toward the ocean. The site is at the point where forest meets more open slopes. The birds include those of both woodland and grassland, such as fruit pigeons and parrots. Especially noteworthy is the Tooth-billed Pigeon, a very peculiar member of the pigeon family, confined entirely to a few islands of the Samoan group.

Pheasants. Birds of the New York Area. *In this introduced game bird, the cock pheasant is more brilliantly colored than is the hen. Brought from China, this pheasant is now familiar over much of the United States and in some locations is semi-domesticated. Its raucous voice has become a part of American life, even a few miles from the heart of New York City.*

Tuamotu. The Tuamotu archipelago occupies a huge area in the central South Pacific and is one of the most extensive island groups on earth. The group represents the island of Hao, an atoll, with the coral-grown lagoon at the left and the surf of the open ocean at the right. In the distant background, tree- and shrub-covered segments of the island ring can be seen. Among the coconut palms and other typical beach vegetation of a coral island are man-o'-war birds, boobies, a nesting Red-tailed Tropic-bird, several terns, including the white Fairy Tern which lays its egg on rough bark or in the crotch of a bush, and also a number of migratory shore birds as well as the rare resident Polynesian Sandpiper.

Marquesas. A scene in the volcanic island of Nukuhiva, showing a rugged shore line and ridges dissected by the sea, as viewed from a height of nearly 2,000 feet. On the right is the Valley of "Typee," famous as the locale of Herman Melville's romance of the same name.

The birds include the Giant Pigeon which exists only at the island of Nukuhiva, a smaller native fruit pigeon, swifts, warblers and Old World flycatchers peculiar to this island, a forest rail, a ground dove and a pair of wild chickens or jungle fowl, the ancestors of which were widely distributed in the Pacific by the original Polynesian immigrants.

Peruvian Guano Islands. Looking southward across the Bay of Pisco, Peru, from the southern island of the Chincha group. The scene shows the rainless coast of Peru where climatic conditions are responsible for the accumulation on such islands of seabird manure, known as guano, which was the fertilizer of the Incas and other ancient farming peoples of the west coast of South America.

Despite the exhaustion of the old supplies of guano, it has again become an important commercial resource in Peru and the industry is now operated upon a scientific basis.

The three principal species of guano-producing birds are shown. These are the Peruvian Cormorant, the Peruvian Booby, and the Peruvian Pelican. Other birds of interest are the white-moustached Inca Tern, and on the rocks of the painted background a distant cluster of Peruvian Penguins.

Galápagos. This scene is in the heart of the Galápagos archipelago looking from James Island across the water toward Albemarle, the largest island of the group. The Galápagos lie on the equator about 600 miles west of the South American coast. They are famous as the native home of many peculiar and long-isolated species of plants and animals, and received their first notable scientific fame as a result of the visit of Charles Darwin in 1835.

Man-o'-war birds, herons, an owl, mockingbirds and hawks are among the birds shown in the exhibit. Most of these are remarkable because of their total lack of shyness in the presence of man, a trait doubtless acquired during residence throughout a very long period in a land without man or other enemies.

The most important of the Galápagos birds from a biological point of view are several species of small finches which show great variation in the shape and size of the bill. Darwin's observations of them in the field had much to do with his original ideas about the evolution of species.

Hawaii. This exhibit shows a deep valley on the Hawaiian island of Kauai. The windward side of Kauai is extremely rainy and, on the right, fragments of storm clouds are shown whisking out over the valley, which, however, is not very humid because most of the rain falls on the other side of the range.

The Hawaiian Islands, like the Galápogos, have been isolated from other land areas throughout many ages, and some of the native birds and other animals show even more peculiar and pronounced evolutionary changes.

Hornbills at their Nest. *This family of white-thighed Hornbills occupies a hollow eighty feet from the ground in a forest tree near the Congo River in Africa. The female remains in the nest with her single egg and helps the male seal her in by plastering shut the entrance. She is confined for about three months and is fed by the male.*

The Hawaiian honeycreepers (Drepanididae), for example, are obviously members of a single family of birds, yet the specializations in the bills of several species range from short, stout, almost parrot-like beaks to extremely long, pointed and sickle-shaped ones. The stoutest-billed species can handle hard seeds and fruits, whereas those with long slender bills must use them in taking nectar or small insects and spiders from inside flowers.

At the right of the group three geese are shown in flight, this rare species, the Nene, (nay-nay), being peculiar to Hawaii. In the air, down the valley, are two White-tailed Tropic-birds, and the small land birds include species having brightly-colored feathers which were used by the ancient Hawaiians in making the famous feather cloaks worn by chiefs of high rank.

Laysan. Albatrosses resort during the nesting season to remote oceanic islands. There they lay the single egg, and rear their chick before they depart once more on the oceanic wanderings which continue until the return of the next breeding season.

Most albatrosses inhabit the southern oceans and no species regularly enters the North Atlantic. The North Pacific, however, is the home of three kinds of albatrosses, two of which are here shown on the nesting ground of Laysan Island, an outlier of the Hawaiian Islands.

Both carry on an extraordinary ritual, commonly known as a courtship dance. The birds salute, cross bills and bow not only to their own mates but to other albatrosses of both sexes.

A pair of the small native teal of Laysan, found nowhere else in the world, is also shown in this exhibit. Others displayed are nesting seabirds, such as boobies, man-o'-war birds and petrels (which occupy burrows in the sandy soil), and shore birds that make the island a resting place during their long migration from Alaskan breeding grounds to a winter home among islands of the south seas — Bristle-thighed Curlews, Golden Plovers, and others.

New Caledonia. This large island, east of Australia, has had no connection with any other land area since it rose from the ocean in the early part of the Age of Mammals. New Caledonia has many birds found nowhere else, including pigeons, warblers, honey-eaters, and the strange flightless heron-like Kagu. The last is a very extraordinary bird which seems to have no near relatives anywhere else in the world.

Solomon Islands. Since the United States armed forces made history at Guadalcanal Island, the savage Solomons no longer seem so far away as they formerly did. In this exhibit of bird life in a hot, humid and mountainous archipelago, the background shows Guadalcanal itself. The foreground represents a small islet off the southeastern end of Guadalcanal, with a cluster of

Peruvian Guano Island Group. *Several islands in the Bay of Pisco, Peru, are shown with their bird life, including the Peruvian cormorant, pelican, booby, penguin, terns and two species of gulls.*

native huts, and a garden in which coconut palms, bananas, papaya, cassava, breadfruit, taro and sweet potato are growing on the site of a recently-felled tropical jungle.

The Solomon Islands have a rich bird fauna. The 21 species shown in the exhibit are only a representative selection. They include the following: the Brahminy Kite, a bird of prey; the Scrub Turkey, or Megapode, which lays its eggs in mounds of rotting vegetation so that the heat of fermentation may hatch them; several species of doves and parrots, including the King Parrot, of which the male is green and the female a vivid red; the Whiskered Tree Swift and various other colorful species.

Philippines. This exhibit shows historic Bataan Peninsula on the island of Luzon, as viewed from nearly 3,000 feet above the sea at the summit of Mount Cayapo. In the middle background is Corregidor, famous island fortress, lying in the channel between Manila Bay and the China Sea. The scars of war have been rapidly overgrown by tropical vegetation and the forests and animal life of the region are relatively unspoiled.

The Philippines have about 325 species of native breeding birds. Of these, 47 are shown in the exhibit, a number not more than half that which might be seen at the site.

Papua. The great island of New Guinea is almost like a continent in the wealth of its plant and animal life. Lying in tropical latitudes its vast mountain ranges nevertheless rise to the level of perpetual ice. Among its 650 species New Guinea has many birds not known in Australia, though the two are only 100 miles apart. On a map of the United States, New Guinea would reach from New York City to Colorado.

The landscape of the Papuan group shows the Laloki River gorge behind Port Moresby in the southern foothills of the Owen Stanley Mountains. At the right is the spectacular Rouna Waterfall. Near here the Allied forces, in bitter jungle warfare, turned back the tide of the Japanese onslaught in the Second World War. The area is now a tranquil wilderness inhabited by birds of paradise, crowned pigeons, cassowaries, and bower birds.

Islands in Bering Sea. Little Diomede and Big Diomede are two islands in Bering Sea, 50 miles south of the Arctic Circle and about midway between Alaska and Siberia. The site of this exhibit is a 1,000 foot cliff at the south end of Little Diomede Island. Here, protected by isolation as well as by the inaccessible nature of their haunts, myriads of murres, guillemots, puffins, auklets, gulls and cormorants come each summer to lay their eggs and rear their young.

Snow Mountains of New Guinea. This exhibit depicts a scene on Lake Habbema, 11,000 feet above sea level, looking southward toward Mount Wilhelmina. Parrots, birds of paradise, honey eaters and flowerpeckers, are among the most characteristic birds of the area. Every altitudinal level has its own bird life, and few of these mountain species can be found in the tropical lowlands. MacGregor's Bird of Paradise is numbered among the

world's most inaccessible birds, living, as so many of the 42 species of paradise birds do, in the remote interior of New Guinea. The Richard Archbold expedition of 1937-1938 was the first to reach this Shangri-La of World War II fame. All of the specimens depicted were flown out from the 11,000 foot surface of Lake Habbema shown in the right center.

Australian Barrier Reef. The Great Barrier Reef, which for more than 1,200 miles flanks the east coast of Australia, is the largest coral reef in the world. In the extensive lagoon between the Barrier and the mainland are countless lesser reefs and islets. Many of these have acquired a luxuriant, plant life. Others, though relatively bare, are far enough above the reach of the ocean to furnish breeding grounds for great colonies of sea fowl.

The birds of the Great Barrier are mostly widespread seabirds. They include a noisy colony of Brown Noddies and Sooty Terns, the fledgling young of the latter being the dark speckled birds which look so unlike their parents. Australian Silver Gulls, Crested Terns, Reef Herons in both gray

Arctic Sea Bird Life. *The group shows the lower part of a 1000-foot cliff on little Diomede Island where myriads of sea birds lay their eggs and rear their young.*

and white phases, and man-o'-war birds complete the list of resident oceanic species. The sandpipers in the beach pool are winter migrants from northern Asia. The white land birds painted in flight are Nutmeg Pigeons bound for fruit trees growing on the islets.

Fiji, one of the great island groups in the South Pacific comprises more than 200 separate islands and islets. The larger ones are mountainous, and many are surrounded by fringing reefs of coral. Fiji has about 54 species of land birds, chiefly those known to be able to make long colonizing flights across the ocean, such as parrots, pigeons, kingfishers, starlings and white-eyes.

In the Silky Dove and the Golden Dove, Fiji has two of the most spectacular of all birds. Most of the arboriginal Fijian birds are confined to mountain districts, while the common birds of town and village are more widespread or recently introduced kinds.

New Zealand. The view looks across Lake Brunner in the South Island Alps. The period is that of several centuries ago when many species of the now extinct heavy and flightless moas lived as browsing and grazing birds in this isolated part of the world. Both plants and birds shown belong to the older life of the islands, antedating the many kinds introduced by man that have since become very conspicuous in New Zealand. The landscape is on the western or rainy side of the mountains at the edge of tall forests of almost tropical luxuriance.

In the absence of enemies and of competing grazing mammals, the peculiar and highly specialized moas took the place of the antelopes and wild cattle that live in other parts of the world. *Euryapteryx*, a moderate-sized moa reconstructed from a subfossil skeleton, is centered in the exhibit. In the extreme left is a large flightless rail, the Takahe or Notornis, long thought to be extinct but recently rediscovered.

Snares Island. To the south of New Zealand, in the west wind zone, lies a small and rarely visited subantarctic group of islets, called the Snares because they are a navigational hazard. Since they have never been inhabited by man or such of his domestic associates as rats, goats, pigs, and weeds, the conditions today are much as they were in primitive times.

The climate is blustery, chilly and rainy. The most conspicuous plants are coarse, tall tussock grass and the "daisy tree" which forms an eerie forest. Seals of several kinds are the only mammals. The birds number a little over a score of species. They include crested penguins, albatrosses, petrels, gulls, terns and skuas. There are only three land birds, a tomtit, a fernbird and a nearly flightless grass snipe.

In December, the southern "June," the sea fowl are nesting, and the multitudinous Sooty Shearwaters or "Muttonbirds" fill the sky toward sunset before dropping, each to its own soggy burrow.

Central Cases. The first case consists of two exhibits, one of the plume-birds of Paradise, and one of the South Sea Lories, a group of parrots. The

The Great Barrier Reef, Australia. *Most of the flying birds in this view are sooty terns. The darker ones are part of a colony of brown noddies.*

second case contains an exhibit of the Rifle Birds, a subgroup of the Birds of Paradise, and, on the other side, various colorful birds of the Malay Archipelago.

SANFORD HALL OF BIRD BIOLOGY

The Sanford Memorial Hall of the Biology of Birds is located on the first floor of The Whitney Wing and is devoted mainly to exhibits illustrating the structure, descent, classification and behavior of birds and their relation to man. The exhibits are in part technical, and they deal with fundamental scientific problems.

A large exhibit of tropical marsh birds in flight against a sunset sky faces the entrance of the Hall, and a number of other habitat exhibits show beautiful and spectacular birds, extinct species, and certain extraordinary aspects of reproductive behavior. At the left of the Hall is the collection of birds of the world designed to show in systematic order examples of virtually all of the families of birds.

A number of remarkable fossil birds are exhibited. Among them is the toothed swimming bird, Hesperornis, which lived in the age of dinosaurs. There are also skeletons of a giant moa, from New Zealand, and of a giant, huge-billed bird, Diatryma, which lived in western North America some 50,000,000 or more years ago. Bones and the egg of Aepyornis, the so-called "Elephant-bird" are also shown. This bird, the largest known, stood at least 10 feet high and weighed about 1000 pounds. Beside it is shown the skeleton of a hummingbird, the smallest bird in the world.

Baby Ostrich. *This baby ostrich has just been hatched from its huge egg. The whole ostrich family may be seen in the "Ostriches and Wart Hogs" group in the Akeley Gallery.*

Elsewhere in the Hall exhibits display aspects of bird life, such as evolution, distribution and migration. One alcove depicts the value of birds to man—both cultural and economic—for this exhibit a special guide book is available.

BIRDS OF THE WORLD HALL

This hall, on the second floor, is given over to a series of habitat groups designed to show the major faunal areas of the world and their characteristic birds. Beginning at the right of the entrance, the groups are as follows:

Argentina Pampas. The pampas and lagoons of the South Temperate Zone of South America harbor a varied assemblage of birds. These include some twenty species of North American sandpipers and plovers that migrate to this region to spend the northern winter. Some of the birds are permanent residents. The scene is laid at Lake Chascomus, near Buenos Aires, a region made famous by the writings of William Henry Hudson, to whom the group is dedicated.

High Andes. The habitat just below snow line in the Andes of South America is called the Paramo Zone. In the neighborhood of Mt. Aconcagua, Chile, shown in the background, this zone is reached at 10,000 feet elevation. The Andean Condor is a characteristic species.

South American Tropics. Barro Colorado Island, in the Panama Canal Zone, was once a hilltop and part of an unbroken humid tropical forest. It was cut off from the surrounding forest when the valley was flooded to form a major part of the Canal. It is now preserved as a natural laboratory well known through the writings of Dr. Frank M. Chapman, particularly by his books "My Tropical Air Castle" and "Life in an Air Castle."

South Georgia Island. The bird-life of the Antarctic regions is not as rich in species as that of the tropics but possesses certain very interesting forms, among which penguins are outstanding. The group shows an

An Extinct Moa of New Zealand.
Reconstructed from a subfossil skeleton.

assemblage of King Penguins on South Georgia, 1,200 miles east of Cape Horn. Among the other characteristic species are the Wilson's Petrel (one of the birds known to sailors as "Mother Carey's chickens"), the Kelp Gull, the Giant Fulmar and (painted) the Wandering Albatross.

East African Plains. The easterly third of Africa is largely a grassy country dotted with thorny bushes and trees. The Kidong Valley, scene of the group, lies some 40 miles northwest of Nairobi, Kenya Colony. The Ostrich, Marabou, Stork, Bustard and Secretary bird are typical of this region.

Congo Forest. The equatorial forests along the Congo River in western Africa are rich in bird-life. As in other tropical forests, many species of birds often band together in loosely mixed flocks that roam the woods for insects and often follow swarms of army ants to prey upon the insects fleeing before these scourges. The exhibit shows such an assemblage of ant-chasers. The scene is at Lukolela, about 400 miles upstream from the mouth of the Congo River.

Australia. This is a scene in the Blue Mountains of New South Wales,

Giant Flightless Birds. *Sanford Hall of Bird Biology. This exhibit shows a number of remarkable fossil birds, among them the toothed swimming bird, Hesperornis, the giant moa from New Zealand and the giant huge-billed bird Diatryma which lived 50,000,000 years ago.*

about 100 miles west of Sydney. Two Lyre Birds (male and female) have come to the forest margin. A flock of Crimson Rosella Parrots has settled on the ground and in the trees, and two Eastern Rosellas are nearby. Several Black-backed Magpies are on the ground or (painted) flying, and a Laughing Jackass or Kookaburra is perched in a tree overhead. Various characteristic birds of eastern Australia are shown. In the distance are scattered groups of the ostrich-like Emus.

Gobi Desert Group. The extensive desert of central Asia, known as the Gobi, contains a number of brackish lakes, without outlets and fed by surface and underground streams from mountains such as the Altai Range shown in the background. The climate is cold except during the brief summer, and the bird-life consists largely of migrant species that go south for the winter, as the Demoiselle Crane, Great Bustard and Ruddy Sheldrake. The Raven remains throughout the year. The Sand-Grouse daily travels long distances for water and has an irregular local migration.

Alpine Group. The Zermatt Valley and the Matterhorn, in Switzerland, are shown with some of the birds of the upper Alps at timberline, such as the crow-like Chough (chuff).

White-breasted Laysan Albatross. *On the Island of Laysan, albatrosses come to nest. They carry on their elaborate courtship procedure, lay their single eggs, and rear their chicks before they go once more on the oceanic wanderings that continue until the return of the next breeding season. The Laysan Group is more fully described on page 122.*

New Forest, England. The group shows the "Theodore Roosevelt Walk" in the New Forest, in Hampshire, where Lord Grey and Theodore Roosevelt watched the birds together in 1910. Many of the more familiar birds of England are shown.

Canadian Tundra. Churchill, Manitoba, on Hudson Bay, lies in what the Indian called the "land of little sticks." Here the Canadian forests to the southward are giving way to the treeless tundra that reaches northward to the Arctic Ocean. In summer the tundra is dotted with innumerable insect-filled ponds. Here to nest come myriads of migratory water birds — sandpipers, plovers, gulls, ducks and geese — that have wintered in warmer lands to the southward. A few land birds also nest on the tundra.

BIRDS OF THE NEW YORK AREA

This completely remodeled exhibit is located in 32 cases in the corridors and main foyer of the first floor of the Roosevelt Memorial building. Despite the great congestion of buildings in the New York metropolitan area, a large variety of birds are still to be seen there annually, though the number of nesting species is dwindling as more and more marshes and other favorable habitats fall before the spread of business and residential construction. This very restriction of habitat, however, leads to some remarkable concentrations of migratory birds. Central Park in particular has long been favored in this respect, and over 200 species of birds have been recorded from this oasis of greenery in the midst of Manhattan.

The exhibit includes more than 300 species of birds which are known to occur with reasonable regularity in the New York area. Both sexes and even immatures are shown when their plumages are different. An unusual feature of this exhibit is the extensive use of scientific study skins, supplemented by a few mounted birds. Many bird watchers have found these research skins equal or superior to mounted birds as an aid to field identification.

Roosevelt Sanctuary Group. Also in the entrance hall of the Roosevelt Memorial Building on the first floor is a group showing many of the summer birds occurring in the Roosevelt Bird Sanctuary at Oyster Bay, Long Island, an area now administered by the National Audubon Society.

OTHER EXHIBITS

Various other exhibits in the Museum contain birds. To mention but a few, the Nile River group in the Akeley Hall of African Mammals contains a fine specimen of the rare and remarkable Shoe-bill or Whale-headed Stork. In the balcony of the same hall is a group "Ostriches and Wart Hogs" containing a family of ostriches, the young just hatching from the huge eggs, the parents concerned with the approach of a group of Wart Hogs, which are enemies of the eggs and young. Nearby is a group depicting vultures, maribou storks and other scavengers at the carcass of a zebra.

mammals

mammals

A mammal is a warm-blooded backboned animal, clothed with fur or hair. The young are fed with milk by the mother. Mice, cats, dogs, horses, elephants. whales, monkeys and men are mammals. Birds, snakes, frogs, turtles and fishes all have backbones but they are not mammals. They have neither fur nor hair nor do they nurse their young with milk.

The Department of Mammals is devoted to their study — classification, physical structure, developments, including growth and size, distribution. adaptation to environment, abundance and many other avenues of research. Field and laboratory investigation results are presented in both scientific and popular publications.

The Department also is responsible for the splendid natural habitat groups to be seen in the various halls. Here the visitor will see representative mammals from all parts of the world, together with the kind of environment in which they live. There is a multiple purpose in such exhibition. The visitor sees the animal at home, he appreciates the relationship between the environment and the kind of creature that can live in it. and he is brought to realize the necessity of preserving such environments if the animals themselves are not to be driven out of existence. Thus, both the aims of education and of conservation are served.

THE HALL OF NORTH AMERICAN MAMMALS

The Hall of North American Mammals is approached from the Hall of New York State Mammal exhibits, Roosevelt Building first floor. It was opened to the public on April 8, 1942.

At the west end of the hall, opposite the entrance, is the ***Alaska Brown Bear Group.*** These great carnivores are shown against the background of the Pinnacles, steep mountains of the Alaska Peninsula. A salmon lies on the shore of a small creek.

On either side of the entrance to the hall are small-scale groups, showing the mammals of North America and their environments during the Ice Age. These animals are now extinct here, although their close relatives exist in other parts of the world. Some of our living mammals could have been found in company with extinct ones. The group to the right shows the mammals found in Alaska. The group on the left depicts those that occurred in southern California.

The ***Grant Caribou*** in their home on the Alaska Peninsula appear in the first large group to the right of the entrance.

Next is the ***White Sheep Group.*** Handsome rams are resting far above the timber line on a mountain in Alaska, with the golden glow of the "midnight sun" striking the white peak of Mount McKinley in the background.

The ***Rocky Mountain Sheep Group*** shows remarkable differences of color and structure from the White Sheep. The massive, closely spiralling horns of the Bighorn contrast with those of the White Sheep. In the foreground may be seen a Mantled Ground Squirrel, locally called "Big Chipmunk."

The ***Alaska Moose Group,*** in the center aisle, displays two great bulls locked in a struggle for mastery over a cow, which appears unconcerned over the outcome. A number of Moose painted in the background indicate their abundance on the Kenai Peninsula, where the scene is laid. A Canada Jay, or Whiskey Jack, perches in a bush to the right of the fighters, and a Spruce Grouse is in a tree to the left of the cow.

The ***Grizzly Bear Group,*** with a male, a mother Bear and her two cubs, is around the corner to the right. They are on the edge of the Canyon of the Yellowstone River in the National Park. The Falls are in the distance, and an Osprey, or Fish Hawk, its nest placed on a rocky pinnacle, soars in the middle distance.

The ***Jaguar Group*** is located in Sonora, Mexico. Two Jaguars, America's largest spotted cats, crouch on a rocky mountainside at sunset.

The ***Mountain Lion Group*** has for its background the picturesque Grand Canyon of the Colorado River. One Mountain Lion lies completely relaxed on the rocky floor of a shallow cave, while the other keenly watches the movements of a deer far below.

Upper left: Alaskan Brown Bear, *the world's largest carnivore. It goes into hibernation on the mountain slopes in the fall and emerges in April or May.*

Lower left: White or Dall Sheep. *These two rams show a pair of bachelors during a period of the year when the sexes do not mingle.*

Right: Bighorn Sheep. *It lives in the rugged mountains far above the tree line and comes down only when forced by deep snow.*

Behind the ***Alaska Brown Bear Group*** is a faunal map of North America.

The ***Wapiti Group*** is on the opposite side of the hall from the ***Mountain Lion Group.*** A splendid bull Wapiti, or American Elk, a cow, a yearling bull and a calf of the year are shown in the northern Colorado Rockies.

The ***Virginia Deer,*** or Whitetail, still occurs in numbers in the New York Metropolitan area, as this scene in Bear Mountain Park testifies. A buck, a doe, and a young of the year stand amid the brilliantly colored foliage of the eastern fall.

The ***Mule Deer Group*** is portrayed with the Devil's Tower, northeastern Wyoming, in the background.

Bison and Pronghorn Antelope on the North Platte River, Wyoming. occupy the large case opposite the ***Moose Group.*** Vast herds of Bison formerly spread from the Appalachians to the Rockies and from Mexico to the Canadian Northwest. The Pronghorn, which is not an antelope and has no close relatives, is the only hollow-horned ruminant that sheds the horns annually.

The ***Musk Ox Group,*** around the corner, demonstrates that the Musk Ox is well equipped for life in the rigorous Arctic regions. In its long. dense coat of fur and hair, it is quite at home in the blizzards of northern Ellesmere Land.

The ***Rocky Mountain Goat Group*** exhibits a billy, a nanny and a kid on a mountain in southern Alaska, overlooking a beautiful fiord, the Endicott Arm.

Above: Wapiti. *This animal is generally known in America as the elk. It in some ways resembles the European Red Deer.*

Lower left: The Mountain Goat *is famous for its sure-footed climbing ability.*

Lower right: The Musk Ox *is now restricted to certain parts of Arctic America, though in the Ice Age it ranged over most of Europe, Asia, and what is now the United States.*

The ***Osborn Caribou Group*** is placed against a background of mountain grasslands in northern British Columbia. Though these Caribou often move down into the forest during winter storms, they do not migrate like the Arctic Caribou of the tundras of the far north. A covey of Ptarmigan may be seen in the background.

Behind the two largest groups, the Moose and the Bison, are the north and south galleries, containing smaller habitat groups.

The North Gallery, beginning to the right of the entrance contains the following:

A ***Gray Fox*** in the Great Smoky Mountains National Park, Tennessee, is eating persimmons dropped to the ground by the ***Virginia Opossum*** plucking the fruit from the branch of a tree above it.

A ***Fisher,*** largest of the martens, is about to launch an attack on the bristling ***Canada Porcupine*** in a spruce tree near Mount Washington, New Hampshire. The porcupine's formidable cloak of needle-sharp, barbed quills is protection enough against most other would-be enemies.

The ***Raccoon,*** shown here hunting at midnight in the Okefenokee Swamp, Georgia, has just caught a crayfish in its highly sensitive fingers.

A family group of ***Beaver*** is shown here in the Gladwin State Game Refuge, Michigan. Not only does this capable engineer construct a well built house and a dam to surround it with a protective body of water, excavates canals for transportation, but also buries a supply of winter food in the mud at the bottom of the pond.

The ***Mountain Beaver*** is not a true beaver though it does favor water courses and feeds on twigs of trees and plants. The animals here are seen cutting plants to be sun-dried in bundles, and excavating in the soft earth at Mount Rainier National Park, Washington.

The ***Canada Lynx*** is the arch enemy of the ***Snow-Shoe Rabbit*** or ***Varying Hare*** which changes from a brown summer coat to a protective white one when the first snow flies. The lynx shown here has come upon its prey near timber line on Mount Albert, Gaspé Peninsula, Quebec. The periodic fluctuations in the number of these hares governs the lynx population.

The ***Western Gray Squirrel,*** a large relative of the eastern gray squirrel, is shown here in the huge sugar pine trees overlooking the Rogue River near Trail in Oregon.

The South Gallery, beginning to the left of the entrance:

The ***Antelope Jack Rabbit,*** so named because it flashes white signals like the pronghorn antelope, favors the cactus country of western Mexico. Its range overlaps that of the ***Black-Tailed Jack Rabbit*** in the desert country duplicated here near Tucson, Arizona. These so-called jack rabbits are really true hares and take their name from the long donkey-like ears.

The ***American Black Bear*** originally ranged over most of North America from timber line to Mexico. The black bear shown here in the Big Cypress Swamp, Collier County, Florida, has wisely left the trail to

Beaver Group, *Hall of North American Mammals*

by-pass the venomous cottonmouth moccasin giving its customary warning—a wide open mouth with fangs bared for action.

The ***Cottontail***, better known as rabbit, is shown in a corn field near Ithaca, New York. It is a prolific breeder and one of the few animals that will not defend itself with its teeth.

These two ***Timber Wolves*** are following the tracks of a deer over the snow-covered ice of Gunflint Lake, near the northern border of Minnesota. The shadows cast on the snow are made by the northern lights seen in the background. The wolf is one of the few animals that apparently mates for life.

The ***Spotted Skunk***, when it meets associates with questionable intentions such as the two ***Cacomistles*** seen here on a rocky hillside at Ship Rock, New Mexico, assumes a threatening attitude by rising up on its forepaws and arching its tail aloft. Skunks can shoot a double volley of blinding, stinging liquid straight into the eyes of an adversary.

The ***Coyote*** or prairie wolf, is a familiar figure in our western states. The two animals in the group are shown against the enchanting background of the Yosemite National Park, California. Bridal Veil Falls can be seen in the distance.

The ***Striped Skunk*** is one of the best known but most unpopular animals in North America. The mother shown here is trailed by her seven young on the New Jersey side of the Delaware Water Gap.

Migration of North American Big Game Animals

Behind the ***Alaskan Brown Bear Group*** is an animated Plexiglass map showing the migration of North American big game animals, showing the mammals that found their way from the Old World to the New, and the horse and camel, which moved from the New World to the Old.

Western Gray Squirrel. *Hall of North American Mammals*

AKELEY MEMORIAL HALL OF AFRICAN MAMMALS

The main floor of this hall, entered from the Theodore Roosevelt Memorial Building, was opened to the public in the Spring of 1936. Here are exhibited mammals typical of Africa, in their natural surroundings.

At each side of the door are sculptured representations of African natives by Malvina Hoffman. At the opposite end are a very large pair of elephant tusks.

In the center, dominating the hall, stands a herd of ***African Elephants*** in characteristic formation when alarmed. The great bull's trunk is raised to test the air for scent, while a younger bull wheels about to cover the rear of the herd from possible attack.

Immediately to the right of the entrance is the ***Water Hole Group.*** The animals of the plains must come, during the dry season. to such seepage holes to drink. Drawn together by their common thirst are Reticulated Giraffes. Grant Gazelles, Oryxes with long straight horns, and Grevy Zebras. Other typical mammals of Kenya are seen in the background.

Next are the ***Mountain Nyala,*** handsome antelopes, on the heather-covered uplands of Ethiopia.

The Rear Guard. *Detail from the great elephant group in the Akeley African Hall. In every herd of elephants, in the wild condition at least, one animal takes the responsibility of wheeling about at intervals to see that all is well behind. The young male shown above is mounted in this position in the herd. It was collected by John T. McCutcheon in 1910 when he was in the field with Carl Akeley.*

This group shows one of Africa's most dangerous and unpredictable animals. A herd of ***African Buffalo*** emerges from the marshes along the Tana River, Kenya, in late afternoon.

A Family Group of Lions rests in the shade of a tree, their tawny hides dappled with sunshine. In the background a herd of antelopes and zebras feeds unconcernedly.

The ***Bongo Group*** shows a pair of these boldly striped antelopes in their native bamboo forest high on the Aberdare Mountains, Kenya. They

have disturbed another typical forest-dweller, the Giant Forest Hog.

The ***Giant Eland,*** in the southern Sudan, is the largest of the antelopes.

The ***Upper Nile Region Group.*** Waterbuck, Kob, Nile Lechwe, Tiang Antelope, Situanga, Roan Antelope and Hippopotamus are found together in this exhibit. A tributary of the Nile, showing sunning crocodiles, forms the background.

At the end of a short hallway, there is a large-scale map of Africa, showing localities from which the various animals and their settings were taken.

To the left of the Upper Nile Region Group is the ***Plains Group.*** Here is the teeming mammalian life of the East African plains. The several kinds of antelope and zebra in this group are typical of this part of Africa.

The ***Greater Koodoo,*** the most prized of the twisted-horn antelopes, bears the longest horns of any. An old male, a female and a young male stand in a setting duplicating the rough, scrub-covered hills where these animals were collected.

The ***Giant Sable*** is noted for its elegant form, deep rich color and long saber-like horns. It is found in a limited area of the dry, park-like country of central Angola and is rapidly becoming extinct.

The ***Gemsbok*** is a larger relative of the Oryx seen in the Water Hole Group. Although once widely distributed in South Africa, the Gemsbok is now common only in dry parts of the Kalahari Desert.

The ***Okapi*** is forest-dwelling and is the only living relative of the Giraffe.

The ***Libyan Desert*** shelters such animals as the Addax, with their spirally twisted horns, the White Oryx, with the scimitar-shaped horns, and the Addra Gazelles.

The ***Gorilla*** family is of particular significance because these great apes are among the most man-like of all the living animals. They are shown here in a clearing in the dense rain forest of the Kivu Mountains, an exact replica of their natural habitat.

Gallery of Akeley African Hall (Third floor)

The first group on the right shows the ***Klipspringer,*** the small, rock-climbing antelope in the background. East African Baboons are in the right foreground and a pair of Mountain Reedbuck appears on the left. Among the rocks in the left foreground is a Hyrax or Cony.

A pair of ***Cheetah,*** fast-running cats, closely watches two Nyalas which have just come out of the forest. This setting is in the country near the lower Zambesi River in Mozambique.

A party of ***Chimpanzees*** is in their tree habitat overlooking the Cavally River, which forms the boundary between the Ivory Coast and Liberia. The animal at the right is in the process of building a nest.

Lesser Koodoo, the males of which have twisted horns, are in company with two Gerenuks — strange, long-limbed, long-necked antelopes with small heads. A flock of Vulturine Guinea Fowl is seen in the background.

A scene from the dense rain forest of the Cameroons shows a group of

Left: Giraffes and Gazelles at a Water Hole.

Above: Grevy Zebra. *These zebras, from the Water Hole Group in the Akeley African Hall, differ from the Grant Zebra, seen in the Plains Group.*

Lower left: African Buffalo. *A herd of African Buffalo along the Tana River in Kenya, from the group in Akeley African Hall.*

Lower right: The Bongo *is noted for its shyness. Very few white hunters have ever seen a wild bongo.*

Mandrills looking for food. The females of these baboons are appreciably smaller than the males.

Impala prefer the park-like country in which they are shown. With their lithe bodies and lyre-shaped horns, the males rank among the most beautiful of the antelopes.

The ***White or Square-Mouthed Rhinoceros*** is miscalled "white" from its habit of wallowing in mud that dries lighter in color. The "square" mouth is an anatomical character. In front of this family group is an African Porcupine.

On the other side of the passage, at the end of which is a large map of Africa, a ***Black Rhinoceros*** family enjoys a mud wallow.

A ***Hunting Dog*** pack at evening looks across the plains to where herds of Wildebeests and Zebras can be dimly seen. The dogs rarely attack these larger species. Gazelles, Impala, and smaller animals are their usual prey.

The ***Hyena-Jackal-Vulture Group.*** Out on the Serengeti Plains, Tanganyika, a pair of lions have killed a zebra. As they withdraw after completing their feast, the scavengers arrive for their share of the spoils. The animals and birds included in this group are a Spotted Hyena, two Black-backed Jackals, White-backed Griffon Vultures, a Ruppell's Griffon Vulture, two Eared Vultures, a Hood Vulture, a Marabou Stork and a White-collared Raven.

Leopards about to spring upon an unsuspecting ***Bush Pig*** is the subject of the next group. The scene is on the edge of a small swamp in the Aberdare Mountains, Kenya.

White Rhinoceros Group. *The White or Square-mouthed Rhinoceros is called white because it wallows in mud that dries lighter in color.*

The Gerenuk *of East Africa, shown on its hind legs, feeding, is said not to drink even in the well-watered Tanganyika country.*

The ***Colobus Monkey Group*** shows a troop of these showy black and white monkeys among the branches of a tree overlooking a section of the Aberdare Mountain Forest, Kenya.

The ***South African Group*** depicts typical mammals of the high veldt as they were when white men first came there. Springbok are now greatly reduced in number and Blesbok and Black Wildebeest have survived only on a few farms where they are protected.

The ***Ostrich Group*** includes a pair of these large birds with young ones just hatched from the eggs. The Wart Hogs would relish the young ostriches but the parents stand guard belligerently.

VERNAY-FAUNTHORPE HALL OF SOUTH ASIATIC MAMMALS

This hall is entered from the left or southern end of the Roosevelt Memorial Hall.

From 1922 to 1928, Mr. Arthur S. Vernay made six expeditions to India, Burma and Siam to collect and give to the Museum this collection. It is considered the finest and most complete exhibit of the larger South Asiatic Mammals in existence.

Two fine examples of the ***Indian Elephant*** stand in the center of the hall, giving due prominence to the largest and perhaps most characteristic mammal of southern Asia. This species differs from the African Elephant

in its smaller ears, higher forehead, and arched back. It also has different teeth and trunk with only one "finger."

The ***Indian Leopard*** differs only slightly from those found in Africa. Both are forest animals but occur in the dry bush country also. They feed on deer, pig, and larger birds such as the peafowl, an example of which has been captured by the Leopard in this group.

The ***Sambar*** is the largest of the Indian deer, found throughout the wooded part of southern Asia. Its size makes it an important source of food for the larger meat-eaters, but it is powerful and may be dangerous when brought to bay. The Red Wild Dog or Dhole of India hunts in packs, sometimes as many as forty strong. These packs are able to kill animals as large as the Sambar.

The ***Black Buck*** is found in the high plains country. The adult male alone is blackish, the females and even young males are yellowish-brown. The Chinkara or Indian gazelle also is found in this country.

The ***Muntjac***, also called Barking Deer, is one of the most primitive of the true deer. Males have well-developed canine teeth. The antlers are supported on bony structures called pedicels. The Mouse "Deer" or Chevrotain is not a true deer, but is more closely related to the Camels.

The ***Lion*** formerly had an extended range, chiefly in the plains country of northern India. It is usually pale in color but does not differ greatly from the several races found in Africa.

The ***Four-Horned Antelope*** is the only living wild four-horned mammal. It is found in small groups in most wooded and hilly parts of India but not in dense jungle. The Smooth Otter is found south of the Himalaya Mountains in India, Burma and the Malay Peninsula.

The ***Chital*** or ***Axis Deer*** is one of the most attractive of the deer family. The young of most deer are spotted. This species retains the spotted pattern throughout life. It frequents the bamboo jungle and wooded regions near water and is found in suitable habitats throughout most of India and Ceylon.

The ***Gaur*** is perhaps the largest of the existing cow-like animals. Large bulls stand over six feet at the shoulder. The Gaur is found in forested hilly country from India to Indo-China and the Malay Peninsula.

The ***Water Buffalo*** occurs in the lowlands and swamps of central India, Ceylon and the Malay Peninsula. Buffaloes have been domesticated and used as beasts of burden and milch animals. The wild buffalo is the most dangerous Asiatic bovine to hunt, for it frequently charges without provocation. A herd will attack a tiger without hesitation.

The great one-horned ***Indian Rhinoceros*** is characterized by thickened skin which has the appearance of plate armor. Its prehensile, or grasping, upper lip shows that it feeds partly at least on leaves and twigs, although it is found chiefly in the grass-jungles of Assam.

The ***Banting*** is possibly the most like the domestic cow in appearance of all the wild bovines, and may be ancestral to the Indian cattle. It is, how-

Colobus Monkey Group, Akeley Gallery.

Upper left: Leopard Group. *The Indian Leopard differs only slightly from those found in Africa. The captured bird is a peafowl.*

Lower left: The Banting *closely resembles the Jersey cow in both its rich brown color and its physical appearance. However, the male Banting's coloration blackens as it grows older.*

Upper right: Siberian Tiger, *from a group in the North Asiatic Hall.*

Lower right: The Giant Panda. *This interesting animal lives in the mountain bamboo forests of Western China.*

ever, closely related to the Gaur. It is found in flat country at lower altitudes. The Banting occurs from Burma and Cochin China to Bali in the Malay Archipelago.

The ***Eld Deer*** or ***Thamin*** is distinguished from other species by the graceful curve of the antlers in the male. It is found on the river plains and in suitable locations east of the Bay of Bengal, from Assam and Manipur to Cambodia, Hainan, and the Malay Peninsula.

The ***Sumatran Rhinoceros*** is related to the Indian species but has two horns and is much smaller. It is found in Assam, Burma, Siam, the Malay Peninsula, Sumatra and Borneo. It is rare and secretive and is found exclusively in forests.

The ***Sloth Bear*** is characterized by the long flexible muzzle which is used to root termites from their deep runways. These bears feed almost entirely on insects, fruits and honey. They climb trees with difficulty. Sloth Bears are usually timid, but if wounded or cornered, they may be dangerous.

The ***Hog Deer*** or ***Para*** is a small relative of the Sambar and is found in the Indo-Gangetic Plain, the flat country in Burma, and much of Indo-China. It is usually solitary in habit.

The ***Indian Wild Boar*** is closely allied to the Eurasian Boar but has a higher crest. It is one of the most savage of Indian mammals, fighting until killed.

Asiatic Water Buffalo. *These buffaloes are the cattle of the grassy Indian plains and are used as draft and milk animals by the natives.*

Gibbons are the least human of the man-like apes and the most disposed to live in trees. They are capable of walking upright but prefer to travel by swinging from branch to branch and from tree to tree. The Hoolock Gibbon inhabits the hills of Assam, Burma, and southern Yunnan. Males are generally black with white brows. Females are often pale yellowish-gray.

The ***Swamp Deer*** or ***Barasingha*** is related to the Thamin, but differs in the shape of the antlers. It is a large species, preferring to live in the neighborhood of water in open forests and on grassy plains. This group also includes a family of Sambar.

The ***Tiger*** is the largest Asiatic cat. Tigers live in the forests and tall grass country, the stripes blending closely with the light and shadow of this habitat. They feed largely on deer and pigs but frequently kill domestic cattle. Individuals too old or decrepit to catch their usual prey may become man-eaters.

NORTH ASIATIC MAMMALS

These may be seen in the circular hall at the end of the South Asiatic Mammal Hall, or through the adjoining Special Exhibition Hall. Eventually, the exhibits will cover the region north of the Himalayas, including Tibet, Afghanistan, Mongolia and Siberia.

Two groups are now completed — ***The Giant Panda Group*** and the ***Siberian Tiger Group.*** Material for the third, or ***Saiga Antelope,*** incomplete, is laid out in one of the cases.

Until such time as other groups are planned and completed, the remainder of the hall is given over to the Corner Gallery, where temporary exhibits of current interest are displayed.

THE HALL OF OCEAN LIFE

Leading from the Hall of Fishes is the Hall of Ocean Life. In it are displayed whales, porpoises, marine mammals, the great ***Coral Reef Group*** and marine invertebrates. Part of the Hall is under reconstruction and it is planned, in the not too distant future, to re-design the entire area to show man's relationship to the sea and its creatures.

Immediately upon entering the hall, the visitor will note the large skeletons and models of whales and porpoises suspended from the ceiling. In the corner, at the left of the entrance, is a model of the ***White Whale,*** a large northern porpoise. Just in front of the entrance to the hall is the striking full-size model of the ***Killer Whale,*** with contrasting black and white markings. The Killer Whale is a fierce hunting animal, capable of swallowing a fur seal or small porpoise at a gulp. Near the Killer and facing it hangs the model of a ***Blackfish,*** which, like the Killer, is a species of giant porpoise, although milder in disposition. Skeletons of these animals are below the models.

Skeleton of the Atlantic Right Whale. *The "whale-bone" is shown in the skeleton suspended from the roof of the mouth as close-set, horny plates.*

Above the balcony in front of the entrance is suspended a life-like model of a ***Giant Squid***, a great backboneless sea animal upon which the Sperm Whale preys. The large skeleton to the right is that of a ***Sperm Whale***, the largest of the living toothed whales. The Sperm Whale was formerly most sought by whalers as the source of spermaceti, a white, brittle, fatty substance found in the sperm-oil in the head of the whale. It was used in making candles and in salves and ointments. Beyond the Sperm Whale, on the same side, hangs a skeleton of the ***Finback Whale.***

Just above these two large skeletons are found skeletons of the ***Narwhal*** and species of toothed whales, including several rare types. At the near end of this row is a Sperm Whale model, and at the far end a small model of the ***Sulphur-Bottom Whale***, the largest animal in the world.

Along the left side of the hall, three skeletons of whales are hung. The one nearest the entrance is a ***Right Whale***, the middle one a ***Pygmy Right Whale***, and the third a ***California Gray Whale.*** Above them is a long row of life-like models of whales and porpoises, ranging in species from the Right Whale and the Common Dolphin to the rare River and Lake Dolphins.

About the center of the row is a model of the ***Pygmy Sperm Whale.*** At the far end are two large models, one of the spectacular ***Narwhal*** with long ivory tusk (at the right), the other the ***False Killer***, formerly a very rare species, but in recent years appearing unexpectedly off the British Isles and the coast of South Africa, where a large number were stranded in shallow water.

Around the walls of the balcony are eleven murals. Along the right side are four great paintings showing scenes typical of ***American Sperm Whaling*** and titled respectively "The Chase," "The Attack," "Towing the Carcass," and "Trying Out." On the left wall are three canvases portraying the life of ***Typical Species of Whales***, including "Bowhead Whale," "Finback Whale," and "Killer Whales Attacking a Gray Whale." These seven murals are the work of Mr. John P. Benson, the noted marine painter.

The walls to the right and left of the entrance bear murals by J. M. Guerry:

left, the Sulphur-bottom Whale; right, Sperm Whale with its favorite food, the Giant Squid.

Below the level of the balcony and hanging just beyond reach from the rail at the head of the stairway is a cast of a ***Young Sperm Whale*** which came into New York Harbor and was eventually made captive in the Gowanus Canal in Brooklyn. It was brought entire to the Museum.

On the main floor of the Hall of Ocean Life and under the balcony are the habitat groups of marine mammals. Beginning at the near right corner, the first of these is the group of ***Northern Elephant Seals,*** huge, ponderous animals that have hauled themselves out on the rocky beach of Guadaloupe Island, Lower California. The full-grown male of this species has a long, hanging proboscis suggestive of an elephant's trunk. Next is the exhibit of the ***Florida Manatee,*** a thick-set beast, well-adapted to its life in the water.

The ***Pacific Walrus,*** one of the largest groups in the Museum, shows these Arctic sea mammals at home on an ice floe in the Bering Sea.

In the first left corner is a large group of ***Steller Sea Lions*** on St. George Island, one of the Pribilofs. The male Sea Lions are huge, powerful seals with massive necks and shoulders.

Many details of the home life of the beautiful ***Alaska Fur Seals,*** on Kitovi Rookery, St. Paul's Island, may be noted. Each vigorous, dominant bull has his harem of sleek, slender cows, while nearby are the bachelor bulls and the playful pups.

On the floor of the hall are several cases with special exhibits. One of these is the ***Townsend Fur Seal,*** a species almost extinct and only recently

A Bull Walrus from the Pacific Walrus Group *in the Hall of Ocean Life. One of the specimens secured by the Stoll-McCracken Expedition to Bering Sea. Group presented by Mrs. Andrew Carnegie.*

rediscovered after it was believed by many to have disappeared completely. Another case displays several types of diving gear with full equipment of pump, telephone, etc.

SYNOPTIC HALL OF MAMMALS

This hall, entered from the Insect Hall, chiefly illustrates various interesting differences in the habits and structures of mammals. It also shows their principal orders and the main subdivisions of these, known as families. Each family is, as far as possible, represented by a mounted specimen and a skeleton.

Starting from the farther or western end and walking around the room from left to right, one passes from the egg-laying Platypus to Man, represented by the figure of an Australian native, armed with a boomerang.

Certain exhibits demonstrate modifications of form and structure for various ways of locomotion, and the superiority of the brain of mammals over that of other backboned animals. Others show albinism (white varieties) and melanism (black varieties). Still others point out that animals outwardly similar may be only very distantly related. How the coat of the hare changes from brown to white and how plants and animals adapt to a desert habitat are also illustrated.

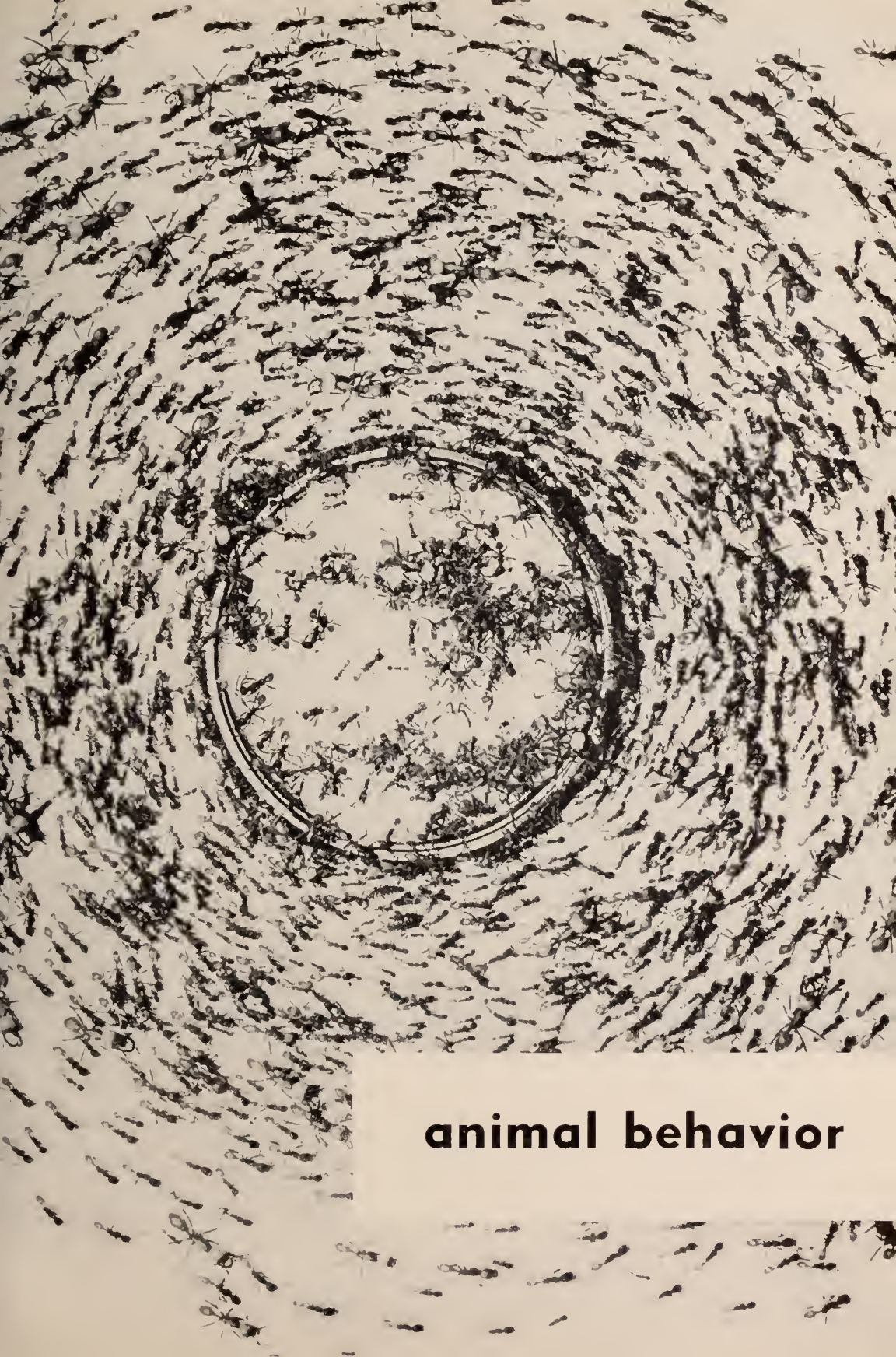
Of special note is the ***Skeleton of Jumbo,*** the largest elephant ever brought to this country alive.

The ***Fruit Bats,*** often known as ***Flying Foxes,*** the largest member of the bat family, and found only in the warmer parts of the Old World, are represented by a small portion of a colony from Calapan, Philippine Islands. Such a colony may be very destructive to bananas and other fruits.

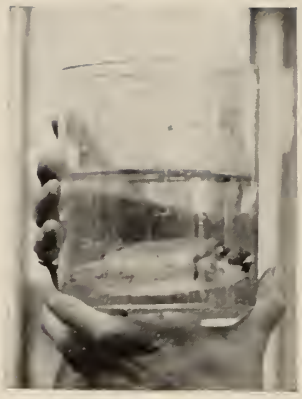
The most striking object in the hall is the suspended life-size model of a ***Sulphur-Bottom Whale,*** seventy-six feet long. The original of this specimen was captured off Newfoundland and the model is accurately reproduced from careful measurements. This species of whale is not only the largest of living animals, but, as far as we know, the largest animal that has ever lived. A specimen of this size would weigh from sixty to seventy tons, twice as much as the extinct reptile ***Brontosaurus.*** Although whales and porpoises live in the water, they are not fishes but true mammals, since they are warm-blooded, breathe by means of lungs, not gills, and nurse their young with milk.

MAMMALS OF NEW YORK STATE

A complete series of the living mammals which have been known to exist within the limits of New York State is presented in the corridor on the first floor of the Roosevelt Memorial in the neighborhood of the elevators. This exhibit includes skins and skulls of all mammals of moderate size, models of the larger species, and cutout figures of the whales and other large sea-animals recorded from the water around New York.



animal behavior



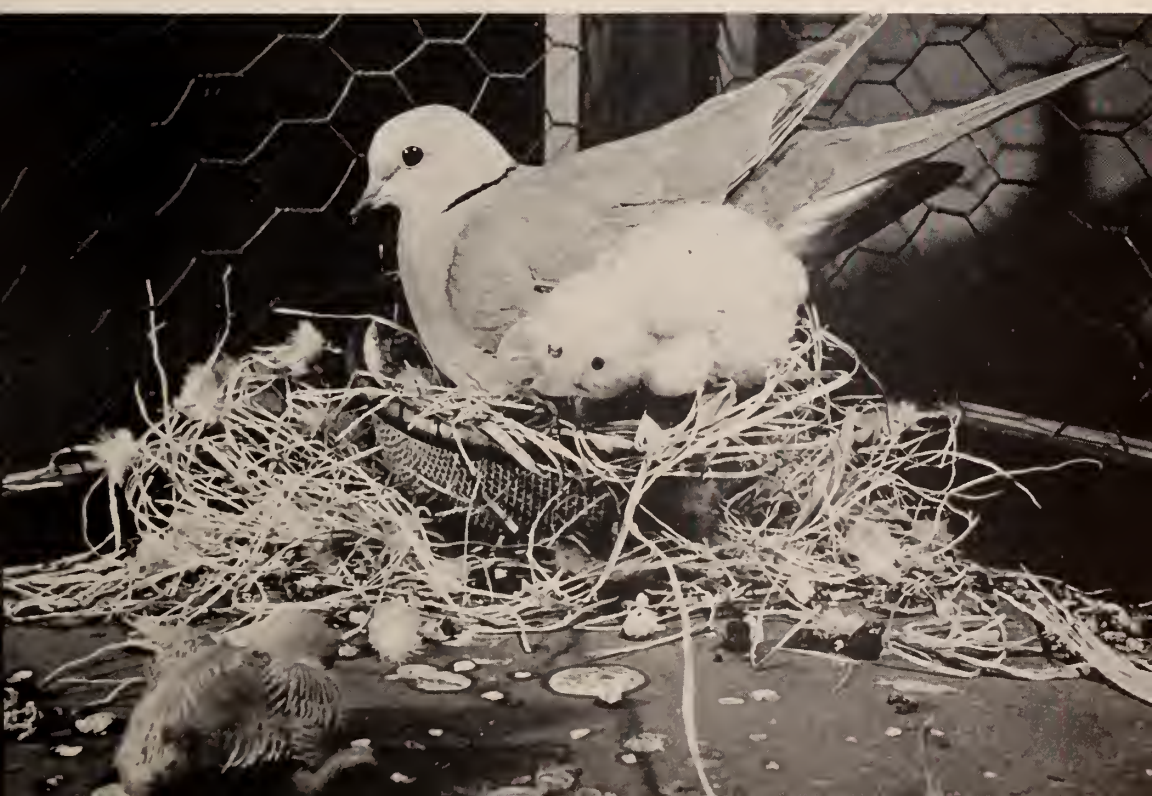
animal behavior

Most visitors are unaware that the Museum also houses a large laboratory devoted entirely to the study of living animals. This is the Department of Animal Behavior which is located on the sixth and seventh floors of the African Wing. Although this area of the Museum is not open to the general public, special science groups are taken through the laboratory when advance arrangements are made. In this way hundreds of students from New York City High Schools as well as college classes have visited the laboratory in recent years and for many, this was their first opportunity to see a research laboratory in operation. The staff of the Department is also available for consultation when important problems concerning animal behavior arise.

About two decades ago, Museum authorities in their deliberations concerning Museum policy decided that while a major function of this institution continues to be the census, classification and structure of animals, attention should also be paid to the relationship of the various animals to each other and to their surroundings. Museum scientists should investigate and exhibit not only what animals do, but also how and why they behave as they do. Thus the Department of Animal Behavior was established so that specialists in the psychology and physiology of animals could study these aspects

African Mouthbreeding Fish Spawning in Laboratory Aquarium. *The female lays eggs in the "nest" as the male stands by to fertilize them. When the last egg is laid and fertilized, the male picks them up and carries them in his mouth until they develop into young fry.*

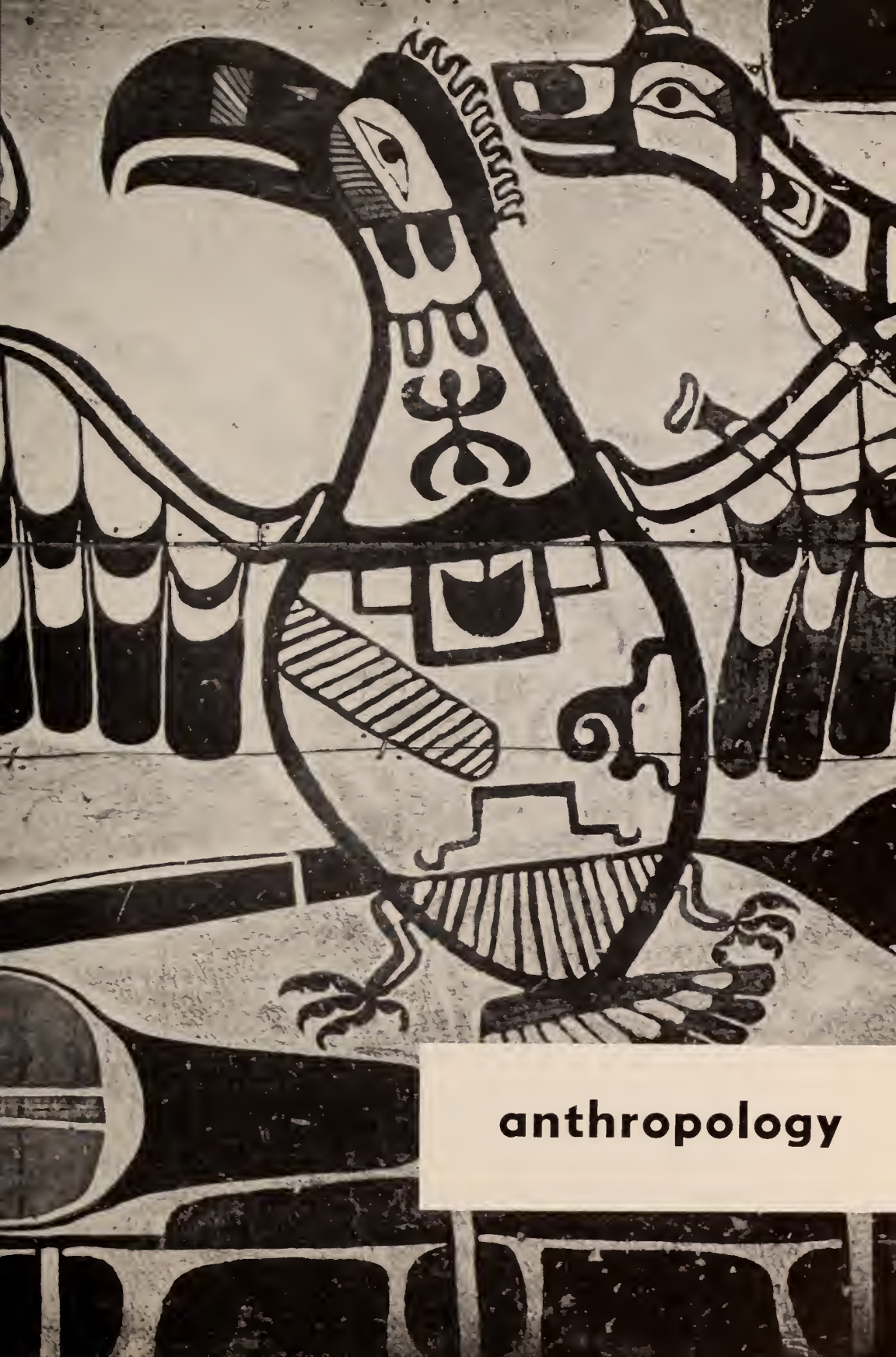
A Simple Test of Parent Behavior in the Ring Dove. *For a considerable part of the incubation and nesting period, the nest locality and the nest itself are attractive to the parents, whereas eggs or young alone are not. In this test, the parent bird, removed from the nest, returned to the nest when given a choice between the nest and the young.*



of natural history, and could be available for consultation particularly in the planning of new exhibits.

Much can be learned by the scientist when he observes how animals behave in their natural surroundings. However, this approach to animal study has very definite limitations. It is generally difficult in a field study to rearrange the surroundings so that a given aspect of behavior can be studied reliably. Laboratory study offers an opportunity to follow up, to supplement or to correct ideas developed in the field. Also many important problems must be brought into the laboratory if they are to be studied at all. For example, some species of fish live in water so muddy that they can be seen only when the seine brings them to the surface. They can be collected in the field, but their way of life remains hidden except to laboratory study. For reasons such as these, the Department of Animal Behavior has a laboratory designed to keep animals alive and in good health, so that their behavior can be observed and analyzed under suitable conditions. A large greenhouse situated on the roof has aquaria for warm water fishes and facilities for other tropical animals. There are flight cages and nest quarters for birds. There are rooms with controlled lighting so that animals can be placed in reversed daylight cycles and thus nocturnal species can be studied during the daytime. There are special air-conditioned and heat-controlled rooms and other means of regulating laboratory surroundings to meet the conditions needed for each type of animal and problem.

The Departmental program is focused upon the important problem of behavior development in the individual and species and upon those types of behavior commonly referred to as "instinctive." Physiological mechanisms involving brain, nerves, glands, and hormones are studied along with social factors, previous experience and finally the general influence of an animal's surroundings upon its behavior pattern. All of these affect the animal's behavior to some extent, and the question is "how." Somewhat as the evolution of animals is reflected in changes from simple to more complex structures, we find among animals an evolution of behavior from the forced movements characteristic of one-celled forms to the elaborate behavior patterns characteristic of mammals and man. For a proper understanding of the evolution of behavior it is necessary to study a variety of behavior patterns in very different animals. Thus as the Departmental program progresses, living quarters are provided for many types of animals under study, usually including insects, fish, amphibia, birds and various species of mammals.



anthropology

anthropology

Anthropology is both a natural and a social science dealing with the complex subject of man as a physical being and also with man's culture — what he does and thinks.

That branch of the science concerned with man as an organism is known in this country as physical anthropology. This includes the evolution of man, the classification of the varieties and races of man as he exists today and has in the past, and various aspects of human biology.

Anthropology, as a social science, has been concerned chiefly with the development and meaning of culture. There are two principal branches: archaeology and ethnology.

The archaeologist works with the tools, buildings, and other objects left by ancient peoples and attempts to reconstruct the history of human culture from the time of its origin through the many thousands of years preceding the periods for which we have written records.

The ethnologist studies and compares the varieties of customs and beliefs of the existing peoples of the world. Both are primarily interested in understanding the nature of human culture — that which can be defined as the body of knowledge, beliefs, customs or ways of doing things which are

passed along from generation to generation by the informal or formal processes of education.

Only by knowing the varied forms that the cultures of man have attained and something of their changes throughout time can we fully understand the unique creature which is man.

HALL OF PRIMATES

The Systemic Series of Primates, intended to give some idea of the types of animals included in this order, and their range in size, form, and color, begins on the left with examples of gorillas and chimpanzees and is continued in the wall cases around the room, ending with the lemurs. Noteworthy among the primates is the gorilla, largest and most powerful of apes; the curious "proboscis" monkey from Borneo; and the aye-aye of Madagascar.

The center corridor contains groups of primates characteristic of various parts of the world — Africa, Asia, South America and Madagascar, and a group of human pygmies living in the forest of central Africa.

Outside of the central corridor, on the left side of the hall, is a group of orangutans from Borneo.

At the farther end of the hall, a series of skeletons demonstrates the comparative structure of the primates and the changes that take place in passing from lemurs to man.

HALL OF THE NATURAL HISTORY OF MAN

The Hall of the Natural History of Man consists of two parts — Introduction to Human and Comparative Anatomy, and the second part dealing with the physical characteristics of the Races of Man, Development, Growth, and related topics.

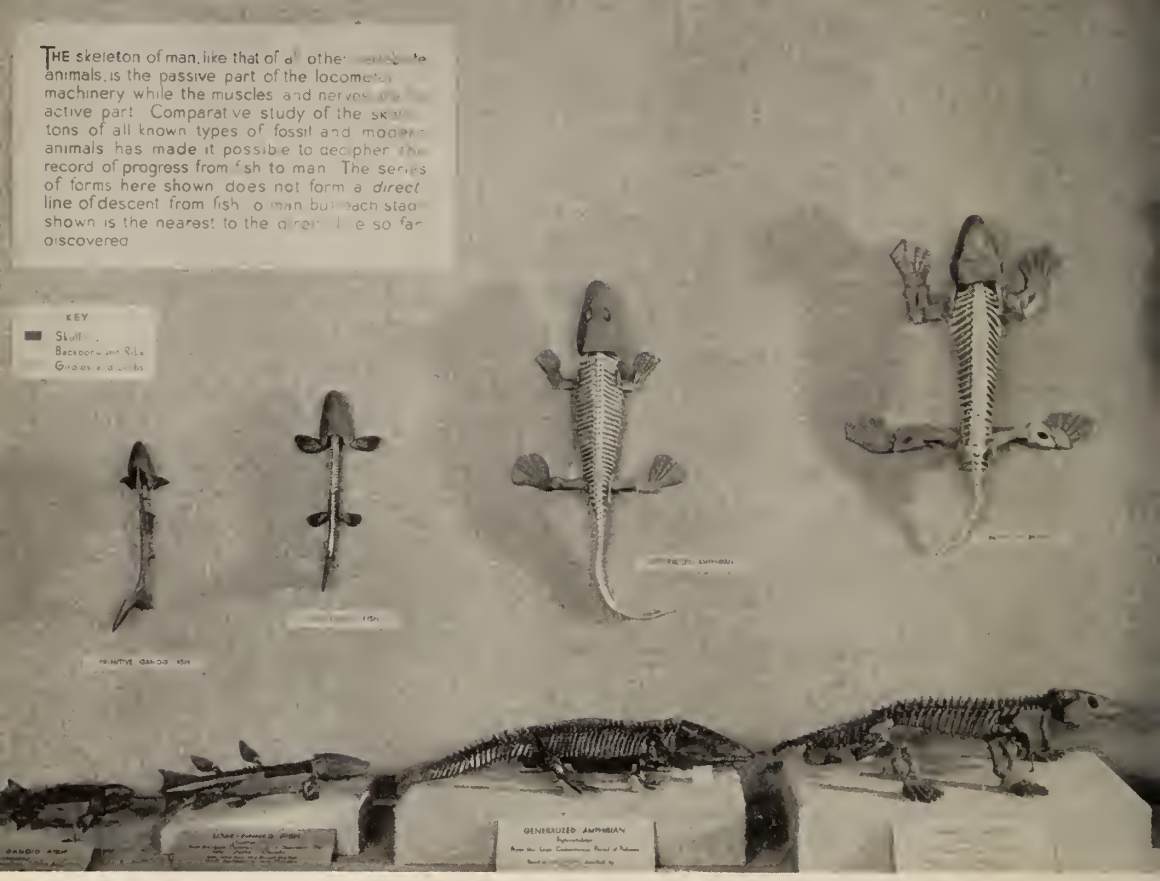
The first part begins by showing ***Man in His Cosmic Aspect,*** with man conceived as a living engine which derives its working capital of energy directly or indirectly from the energy of the sun stored up in plant and animal tissue. This energy is appropriated by man in food substances and distributed through the various anatomical systems.

In another exhibit the ***Elements of the Locomotor Apparatus*** in backboned animals are set forth. It is shown how red muscle fibers of the fish are combined into W-shaped muscle segments or myomeres and how the muscles of man are constructed.

Other exhibits deal with the anatomy of man as compared with lower backboned animals, following the chief organ systems of the body and the parts concerned with locomotion.

The ***Position of Man Among the Vertebrates*** and the evidences of his evolution from lower backboned types are shown by comparisons of skeletal structure in living and in fossil types, and by comparisons of his muscle system with lower forms, as well as by comparative embryology. An analysis of the nervous system, and the evolution of the human brain are dealt with, and the functions of the brain are demonstrated.

THE SKELETON FROM FISH TO MAN



Stage 1 *Primitive Ganoid Fish (Cheirolepis)*

Stage 2 *Lobe-Finned Fish (Eusthenopteron)*

Stage 3 *Generalized Amphibian (Diplovertebron)*

Stage 4 *Primitive Reptile (Seymouria)*

The First Four Stages from Fish to Man *(From water-living to land-living)*

The second part of the exhibit, on the right side of this hall, is devoted to ***Exhibits Illustrating Human Biology.*** Shown are exhibits of the growth and development of a human embryo, skeletal growth in the head, and the variety of physical types of man as modified by glandular secretions. A series of full-size figures showing some of the major racial types of man has been placed in the central alcove.

Two charts are also displayed in this alcove. One illustrates the natural habitats of the various racial types exhibited. The other depicts the major population movements throughout the world since 1492.

At the far end of this side of the hall will be found an exhibit on some of the more important endocrine functions.

Stage 5
Cynodont Reptile or Pro-Mammal (Cynognathus)

Stage 6
Archaic Mammal Opossum

Stage 7
Very Ancient Primate (Notharctus)

Stage 8
Primitive Anthropoid Gibbon

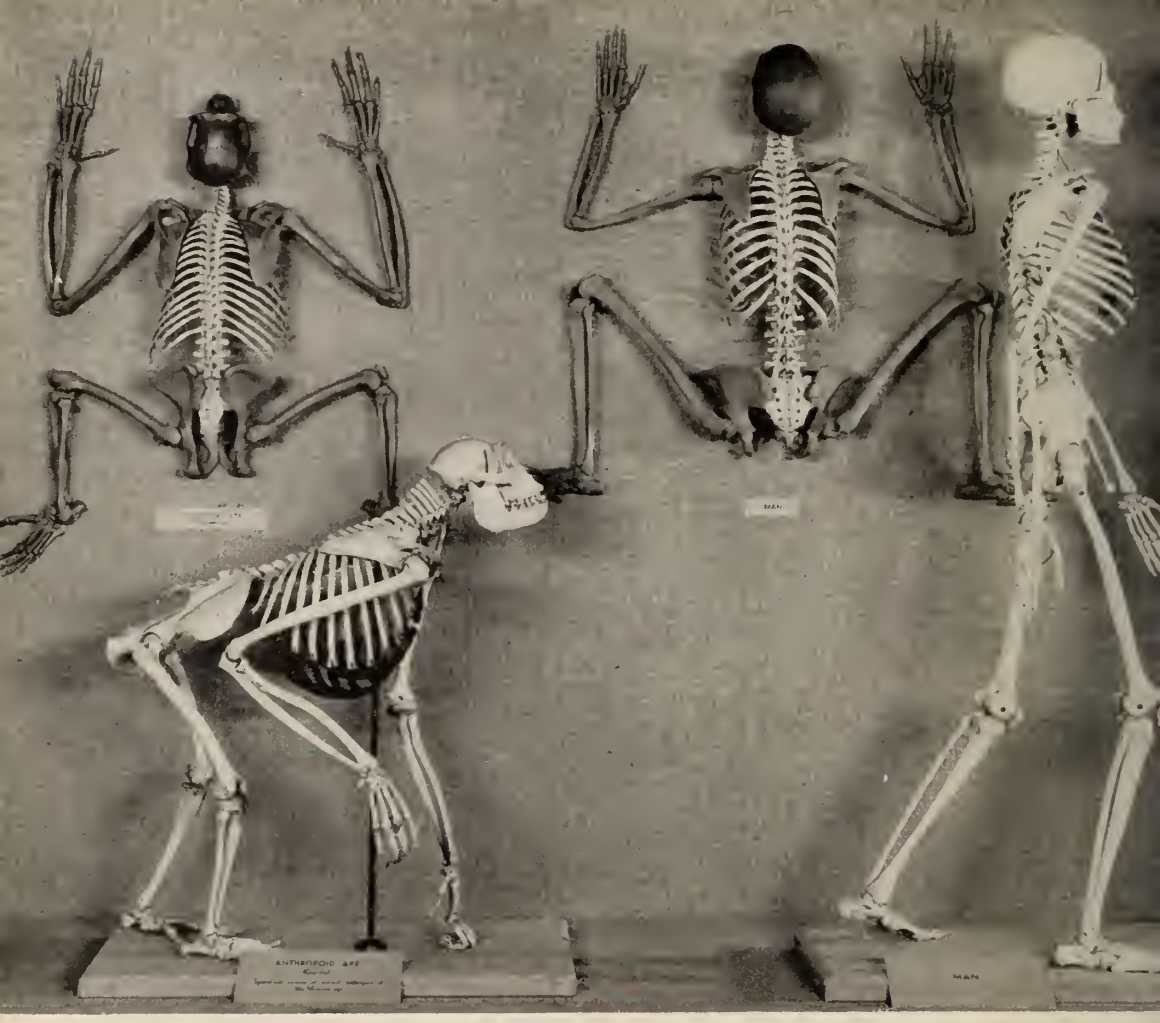
The Second Four Stages from Fish to Man *(From ground-dwelling to tree-dwelling)*

The Skeleton from Fish to Man

The judgment of science is that our pre-human ancestors only reached the grade of humanity after many millions of years of evolution from lower to higher grades of life.

Owing to the enormous number and variety of organisms in nearly all geologic ages, and to the wholesale destruction of their skeletons by natural agencies, only a small number of the fossil forms which we have discovered to date happen to lie in or near the direct line of ascent from fish to man. Nevertheless, the story of the evolution of the skeleton from fish to man is clear in its main outlines as shown in this exhibit.

The ***First Stage*** represents the earliest true fishes by a model of a fish



Stage 9
Anthropoid Ape (Chimpanzee, above; Gorilla. below)

Stage 10
Man

The Two Final Stages from Fish to Man *(On the ground again, and attainment of erect posture)*

in the early stage of evolution of higher bony fishes. This fish, which breathed by gills in the normal fish way and which perhaps had a simple air-sac or lung, must have looked something like a trout, but its tail was more like that of a shark. The body moved forward in the water by a wriggling movement caused by the contraction of the regularly arranged muscle segments along either side of the body. The axis of the body was an elastic rod called the notochord, similar to that which appears in the embryonic stages of all higher backboned animals, including man. The fins were composed of rays serving as keels and rudders.

The ***Second Stage*** represents a long step in advance. It is based on a fossil fish named Eusthenopteron, from the Upper Devonian of Canada. This

fish still had gills but there is some evidence that it also possessed an air-sac or lung. It had two pairs of paddles, corresponding to the fore and hind limbs respectively of four-footed land animals.

The ***Third Stage,*** from the Carboniferous Age, represents the oldest known type of four-footed animals. The skeleton of the hands, feet and limbs is much more developed than in the previous stages. There are five digits on each of the hands and feet.

The ***Fourth Stage*** represents the primitive reptilian or lizard-like stage from the Lower Permian of Texas. The skeleton on the whole is not greatly different from the preceding stage, except in detail, but the limbs are better developed.

The ***Fifth Stage*** represents an advanced mammal-like reptile *(Cynognathus)* from the Upper Triassic of South Africa. In this form the limbs are better adapted for running, and there are many features of the skull, backbone, and limbs that approach the condition in mammals.

For the ***Sixth Stage*** the skeleton of a modern opossum is used. It retains in the main the leading characters of the skeleton of the older fossil mammals. This form has five-toed grasping hands and feet, by means of which it climbs about in the trees. It has kept a relatively low type of skull, teeth, and brain.

In the ***Seventh Stage*** we come to *Notharctus,* a form that lies near the lower limits of the order of primates to which man belongs. These animals were thoroughly adapted to life in the trees but they had much larger eyes and bigger brains than any of the preceding stages.

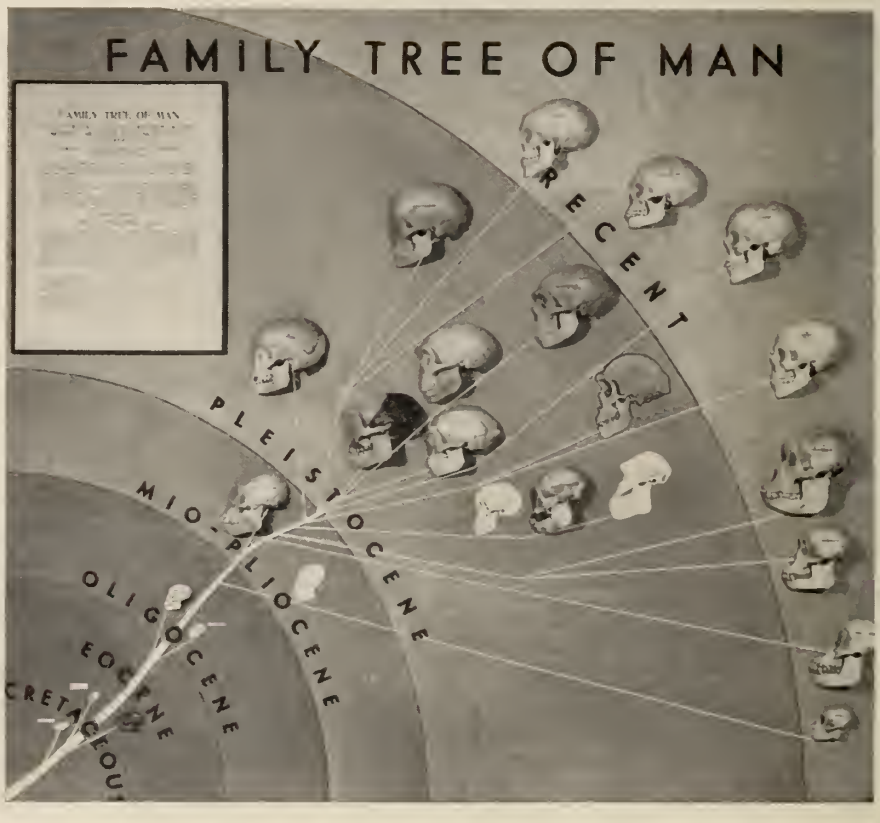
The ***Eighth Stage*** is represented by the skeleton of the gibbon, an East Asiatic ape which is a tree-living descendant of the first family of the tailless or man-like apes. When on the ground it is the only existing man-like ape which normally walks on its hind legs. Its skeleton begins to be almost human in many ways but the arms are excessively long.

The ***Ninth Stage*** is represented by our distant cousins, the gorilla (below) and the chimpanzee (above). These apes retain the essential characters of fossil apes from India and South Africa, some of which approached quite near to the oldest known fossil men. The ape brain is much more developed than the brains of lower animals, and ape intelligence at times is almost human.

In the ***Tenth Stage,*** we see that the human skeleton is built on the same general plan as that of the chimpanzee, gorilla, and gibbon, but that in man the backbone, pelvis, and limbs are modified to enable him to walk on his hind legs and to use his forelegs as arms and hands rather than as supports. His brain is much larger and more highly developed than in the apes.

OSBORN HALL OF THE AGE OF MAN

This hall is devoted to early man and his contemporaries, the mammoths and mastodons, and the giant ground sloths of South America. The visitor learns what is known of the early history of our own race as shown by the



The Family Tree of Man *shows the evolution and relationships of the principal branches of mankind and of anthropoid apes, using models of various skulls for study.*

remains of early man and the implements he used. As fossil remains of man are rare and usually very fragmentary, these are represented mainly by casts, but they include examples of all of the more perfect and noteworthy specimens that have been found, from *Pithecanthropus* and *Sinanthropus* to *Neanderthal* and *Cro-Magnon*.

In the surrounding cases are some of the principal skeletons and skulls of animals mostly of the Pleistocene Age (see Time Chart on p. 59) known to have been associated with man especially in North and South America. Skeletons and skulls on the right side of the hall show the evolution of the Proboscidea. They fall naturally into two groups: first, the mastodons; and second, the mammoths and elephants. In the former division, beginning near the entrance of the hall, are the most primitive mastodons, with two upper and two lower tusks, and a very short proboscis. The succeeding cases show the gradual reduction of the number of teeth and the shortening of the front part of the skull for the accommodation of the longer proboscis found in all of the later stages of mastodons and mammoths.

On the left is a group illustrating the famous asphalt trap of Rancho la Brea at Los Angeles, California, and fossils from South America, the most

Restorations of Head and Shoulders of Early Man. *Professor J. M. McGregor, following scientific principles and using the skull-remains of the various types as a starting point, made these restorations of, left: Trinil Ape-Man, middle: Neanderthal Man, and right: Cro-Magnon Man.*

striking of which is the group of giant ground sloths. There are also good examples of gigantic relatives of the armadillo, the glyptodonts or "carved-toothed" animals.

Among other strange extinct animals are the camel-like ***Macrauchenia***, and the rhinoceros-like ***Toxodon.*** These evolved in South America during the Age of Mammals when it was an island continent as Australia is today.

On the walls are mural decorations painted by Charles R. Knight, showing the typical groups of Pleistocene animals of North and South America and Europe that were associated with early man.

In the ***Hall of the Natural History of Man*** we see models of various skulls, ranging from the earliest Primates of the Eocene Period, through the monkeys and apes of the Miocene and Pliocene, to the subhuman and human races of the Pleistocene and Recent ages.

The exhibits in the central aisle of the ***Hall of the Age of Man*** deal mainly with the older races of mankind as shown by their fossil remains and by preserved fragments of their handiwork.

Men of the Stone Age. Here we see a representation of the newly discovered *Australopithecus* of South Africa, a skull cast of Trinil, or Java "ape-man," and skeletal remains or cases representing Peking Man, Heidelberg Man, Neanderthal Man, and Cro-Magnon Man. An excellent series of sculptured restorations of these types, three of which are illustrated below, have been made and are generally considered as embodying the most recent scientific deductions as to the general appearance of these primitive races of mankind. The earliest of them takes man back at least to the lower Pleistocene, estimated at 1,000,000 years ago.

A series of mural paintings by Charles R. Knight over the doorways of the Hall of the Age of Man gives a vivid idea of the various races of early man as seen by the artist in harmony with our best scientific knowledge.

The ***Hall of Prehistoric Cultures*** on the second floor also exhibits the early arts and industries of the European Cave Men and Lake Dwellers, as well as North American prehistoric men.

LIVING RACES OF MAN

The Woodlands Indians

(Note: Because the Woodlands Indian, Plains Indian, and Southwestern Indian Halls are closed during the construction of the Biology of Man Hall, these exhibits may not now be seen. However, the material on these Indians is still included in the General Guide because of the value to students and other visitors interested in Indians.)

Walking to the left on entering the Museum from 77th Street, we meet first the Indians of New York and New England. The successive exhibits are so arranged that the visitor can imagine himself traveling across the United States from east to west.

Although called the Eastern Woodlands Indians Hall (northeastern United States and Canada), the exhibits in this hall include the Southeastern and Mackenzie culture areas, the former joining the Eastern Woodlands on the south, the latter on the northwest. The whole Eastern Woodlands area was in forest and reached westward from the Atlantic coast to the Mississippi River. Objects on display show that these Indians lived in the forest. The materials they used came from the forest, and this fact influenced their houses, tools, weapons, clothing, and ornaments, so that they are readily distinguished from those of other areas.

These forest Indians were primarily hunters and fishermen but they also ate wild rice and maple sugar. They grew corn, beans, squash, tobacco and other plants where the climate allowed. (See minature dioramas at north side of hall.) Their woodland environment led to simple industries dependent upon the raw materials that were at hand and adaptable to their daily needs.

Wood was used for canoes, mortars, spoons, bowls, dishes, houses and wood splint baskets. Bark of various kinds was a favorite material. For example, the birchbark industry is illustrated not only by a diorama but by containers and ornaments in many of the cases. Bark like that of the basswood tree was also shredded to make the fiber for weaving bags.

Skins were originally used for costumes, but, since the Woodlands area was one of the first regions of North America to be influenced by European contact, cloth was often bought from white traders. Many wild plants and trees furnished fiber from which these Indians made good string and cord for making fish-nets and for weaving bags. Every well-equipped house required mats for the floor and for sleeping.

Top: Uses of Birchbark among the Eastern Woodlands Indians. *(From a miniature diorama in the Woodlands Indians Hall)*

Middle: Eastern Woodlands Agriculture. *A miniature diorama showing the Iroquois Indians of New York State clearing the land and tilling the soil.*

Bottom: The Seminole Indians of Florida. *(From a miniature diorama in the Woodlands Indian Hall)*

Climate influences the ways of life. In this hall, the tribes represent a range from near-Arctic Canada to sub-tropical Florida. Their clothing varies from fur garments among the Dene and the Cree, to thin dresses of commercial cloth among the Seminole.

A number of miniature groups along the side walls and in the cases show tribal costumes, housing and industries. Especially interesting subjects are rock shelters, the making of rabbit skin clothing, weaving with basswood fiber, making a false face, and the stages by which corn is made into bread.

Travel was on foot. Dugout or bark canoes were used in summer where streams or lakes were accessible. Snowshoes were used in winter, and in the north the toboggan was common.

The dwellings of this area are of several forms. Among these are the long rectangular houses of the Iroquois covered with oak bark, the dome-shaped huts of Long Island and vicinity which were covered with mats and bundles of grass, and the familiar cone-shaped wigwam of the Ojibway covered with birchbark. The utensils are of pottery, wood or birchbark. Pottery was made by most of the Eastern tribes and seems to be associated with farming. The designs are cut in, cord-marked, or paddle-stamped, but never painted.

Bowls, trays and spoons are made of wood and are often decorated with animal carvings. The use of birchbark in making light household vessels is one of the particular traits of our Eastern Indians.

These Indians invented canoes, maple sugar, tobacco pipes, cornhusk weaving, splint baskets, tump-lines or devices for carrying heavy loads, wampum, the game of la crosse, netted snowshoes, the toboggan and the water-drum.

The Indians' history begins with the landing of white men. Many of the objects shown in the cases are historic, but others, such as the stone, bone and shell objects found in the ground, are usually prehistoric. In the exhibits dealing with Manhattan and Staten Island, from which the Indians were driven by the first settlers, we can show nothing but pottery, stone, bone and shell objects. These local relics will be found near the entrance to the hall. On the left are some pottery vessels and many small objects made of stone and bone from Manhattan Island, Staten Island, Long Island, and Westchester County. Nearby, on the same side of the hall, are collections obtained from living Indians of the coast region north and south of New York. These are the Penobscot and Passamaquoddy of Maine, the Micmac and Malecite of the lower provinces of Canada, and a few rare objects from the Delaware who once occupied the vicinity of New York City and the State of New Jersey. The age and historical relations of these cultures are shown in a large label at the left of the entrance.

A family group of Micmac Indians, in a birchbark cone-shaped house, is shown half way down the hall.

On the opposite side are the Iroquois, whose league included the Mohawk,

Dakota Warrior and Dakota Woman. *These life-sized models in the Plains Indian Hall show in detail the typical costumes and decoration of this famous Indian tribe, which depended on the buffalo almost entirely, for food, clothing and shelter.*

Seneca, Oneida, Onondaga, Cayuga, and later the Tuscarora. They dominated New York and much adjoining territory. The exhibits represent particularly the agriculture of the East, which was carried on with rude tools by the women.

In the farther end of the hall, on the left, are the collections from the Ojibway, who lived mainly north of the Great Lakes. They had but little agriculture, living chiefly by hunting and fishing and the gathering of wild rice. Beyond the Ojibway are the Cree, who lived farther north.

Opposite the Ojibway are the great Central Algonkin tribes, the Menomini and Sauk and Fox, as well as the Siouan Winnebago, who lived south and west of the Great Lakes. They too gathered wild rice and hunted and fished and also did some farming.

In the southeastern portion of the United States, agriculture was highly

developed. These tribes are represented by the Cherokee and Yuchi, who made pottery, and by the Choctaw and Chitimacha, who made fine baskets of cane as well. The Seminole of Florida, though long influenced by the white man, have maintained an independent existence in the Everglades for nearly a hundred years. Their prehistoric arts are illustrated in the table case. They excelled in polishing stones and working shell. (See the diorama on the north wall.)

The Plains Indians

When we think of Plains Indian life, we think of such terms as "tipi," "buffalo," "horse," and large decorated "pipes." The tipi and the pipe are especially conspicuous in the center of the hall.

The art of these Indians is highly original and popular. Painting on skin is the usual method, but many designs in beadwork and quills are shown.

Artists look upon the feather headdress of these Indians as the most beautiful type of headdress to be found anywhere in the world. With this and his highly decorated costume, the Plains Indian is a colorful figure.

Indians of the Plains made up the tribes living west of the Mississippi and east of the Rocky Mountains as far south as the valley of the Rio Grande and as far north as the Saskatchewan.

Beginning on the left, the buffalo-hunting tribes: the Plains-Cree, Dakota, Crow, Blackfoot, Gros Ventre, Arapaho and Cheyenne, occupy the greater part of the hall. These tribes did not farm but depended almost entirely on the buffalo. They ate the buffalo and used its skin to make their clothing. Sometimes a buffalo paunch was used for cooking, and horns were made into various tools and weapons. The spirit of the buffalo was thought to be a powerful ally and was called upon to cure sickness, to ward off evil, and to give aid in the hunt. Wherever the buffalo herds led the way, the more nomadic Plains tribes moved their tipis and followed. When most of the buffalo were wiped out, the entire life of the Plains Indians was revolutionized.

On the right, near the entrance, are the village tribes of the Plains: the Mandan, with whom Lewis and Clark passed the winter of 1804-1805; the Hidatsa, who now live with them; and the Omaha, Kansa, Iowa, and Pawnee. All these tribes raised corn and lived in large earth-covered houses. A small model of one of these houses stands near the exhibits.

In the center of this hall is a Blackfoot Indian tipi with paintings of otters on the sides, representing a vision of the owner. This tipi has been fitted up to show the home life of a typical buffalo-hunting Indian.

There were numerous soldier societies among the Plains Indians which included practically all the adult males. Each society had a special dance and special costumes. (See the Arapaho cases for costumes of dancers.) There were other dancers connected with tribal religious ceremonials, the best known and most important of which is the Sun Dance, shown by a model at the left of the tipi. The Sun Dance was held yearly in the early summer

A Blackfoot Indian Tipi. *The interior has been furnished with scale models showing typical Plains Indian life of the nineteenth century.*

to keep a vow made the winter before by some member of the tribe who wished a sick relative to recover. The dance involved self-torture, great physical endurance and a fast lasting three days.

In the center of the hall is a medicine pipe, held in awe by the Indians and dearly parted with; also the contents of a medicine bundle. The contents of another medicine bundle, belonging to a leading medicine man of the Blackfoot tribe, together with the headdress which he wore in ceremonies, are in a case near the tower. Other remarkable bundles, particularly the skull bundle, are in the Pawnee case on the north wall.

The Plains Indians are noted for their painted buffalo robes and for their quillwork, which was superseded by beadwork when glass beads became available in historical times. They have a highly developed decorative art in which simple geometric designs are the elements of composition. This is one of the most interesting features of their art. (See Dakota case.)

Indians of the Southwest

This region is famous for two reasons: its picturesque living Indian tribes, and the large number of ruins built by prehistoric Indians. Since many of the latter are placed upon high rocks or in the walls of canyons, they are spoken of as Cliff Dwellings.

This hall presents collections from both the prehistoric and the living Indians of the Southwest. On the right are the nomadic or wandering tribes: the Apache, Navajo, Pima, Papago, and Havasupai. A life-size exhibit, the first of a series along the right-hand wall, shows the home life of the San Carlos Apache. Next is a larger group showing a Navajo hogan in Canyon de Chelly, and the Night Chant ceremony. The painted background of this group gives a view of the canyon and the famous White House ruins.

Navajo silverwork and blankets are shown in nearby cases. The Navajo are the modern blanket makers. They card, spin and weave the wool of the sheep they raise with simple implements and looms. This art has arisen since the coming of the Spaniards and it is known to have passed through several stages in the last sixty years. Some of the older types of blankets shown here contain yarn which was gotten by cutting or raveling from imported flannels, called in Spanish "bayeta," from which these blankets get their name. These are either bright red or old rose in color, resulting from cochincal dye. Several blankets are made of yarn bought ready-dyed from traders and are called Germantowns. The greater number, however, are made of yarn of native spinning, dyed with native vegetable and mineral dyes.

The Navajo are a large and widely scattered tribe. During the winter they live in log houses, but in milder weather they camp in the slight shelter of a cliff or windbreak and shade made of brush. They live by raising corn in the moist valleys, and on the flesh of their many flocks of sheep.

The Western Apache live along the upper portion of the Gila and Salt Rivers, where they farm, gather natural products and hunt. Indians related to these, under Geronimo, raided the settlements of southern Arizona and northern Mexico and evaded our troops for years. They live in grass-thatched houses or in the open under the shade of flat-topped open-sided shelters.

The Eastern Apache lived in buffalo skin tipis. They went far out on the plains in search of the herds, avoiding, if possible, the Plains tribes, but fighting them with vigor when necessary. In dress and outward life they resemble the Plains Indians, but in their legends and ceremonies they are like their Southwestern relatives and neighbors.

In the first alcove to the right of the entrance is a basketry exhibit showing the types of baskets and the materials, tools, and techniques used by the Southwestern tribes. This exhibit is in contrast with the corresponding case of pottery on the opposite side. Not the environment, but social habits, caused one people to develop pottery and the other to make the easily carried and not easily breakable baskets.

A Navajo Medicine Lodge.
Southwest Indian Hall.

At the left of the hall, as we enter, are exhibits for the modern village Indians — first types of pottery from San Ildefonso, Laguna, Santo Domingo, Zuni, and Hopi.

The Pueblo Indians live in large community houses, built of stone or adobe, often with several stepped-back stories. They depend chiefly on farming for their food, make a great variety of pottery, and have many elaborate religious ceremonies. The nomadic peoples live in tipis or small brush and thatched houses which are moved or deserted when they are forced to seek the wild game and wild vegetable products which furnish much of their food. They make baskets for household purposes which are more easily carried than vessels of clay. In the hall are models of the pueblos of Taos and Acoma, of prehistoric cliff-dwellings, and of the houses used by the Navajo.

The inhabitants of Zuni are believed to be the descendants of the first people seen by the Spaniards in 1540. Their former villages, many of which are now in ruins, were probably the "Seven Cities of Cibola," for which Coronado was looking at that time. Although there were missionaries among them for about three hundred years, they have kept many of their own religious ceremonies. Many ceremonial objects, as well as those of every-day life, are shown in this alcove.

In the Hopi section are costumes, masks, images, and basketry plaques used in their ceremonies. Their best known ceremony is the Snake Dance, supposed to increase rainfall and the crops. Some of the regalia worn for

Hopi Snake Dance. *This is given on alternate years by the Snake and Antelope priests in all but two Hopi villages to insure the rain needed for the crops. (From a miniature diorama in the Southwest Indian Hall)*

the Snake Dance are shown, as well as a small model of a single phase of the ceremony. In the center of the hall a table case shows a Hopi altar, of the type that figures in nearly all Hopi ceremonies.

In the center of the hall, as well as in the farther half of the left side, are special exhibits for the prehistoric Indians of the Southwest. Near the center is an exhibit showing how many prehistoric ruins have been dated by the tree-ring method. A chart at the entrance to the hall gives the successive culture periods for the Southwest, beginning with early Basket Makers and ending with the modern Pueblo villages. Typical objects made by the Basket Makers are shown in small cases in the center of the hall and in upright cases to the left.

Two of the most famous prehistoric Southwestern ruins are Bonito and Aztec. A model of the latter stands in the center, and near the entrance is an exhibit of turquoise from Pueblo Bonito. Other collections from these two ruins are shown in cases at the left of the hall. One contains a remarkable collection of pottery from Pueblo Bonito. Similar black-on-white wares with very elaborate and splendidly executed designs, shown in adjacent cases, are from Rio Tularosa, and in part from cliff-dwellings. In another case is found material gathered by the Museum expedition which explored the Galisteo Valley, New Mexico.

Other exhibits in this area illustrate the culture of the living Indians of California. Most outstanding of the achievements of these tribes was their basketry, some examples of which are among the finest produced in the world.

Model of a Kwakiutl Village, Vancouver Island. *Plank houses face the sea with canoes on the shore. Owner's crests are painted on house walls and carved on the house posts in front.*

Indians of the North Pacific Coast

The Jesup North Pacific Hall is devoted to the Indians living in the heavily forested and mountainous coastal belt extending from the Columbia River in Washington to Mt. St. Elias in southern Alaska, as well as on the offshore islands. They are the most skillful wood workers on the American continent, as shown by the models of their houses; their intricately carved and painted totem, house, and grave posts; their ceremonial masks, boxes, implements, and tools. They depended on their forest environment for housing, clothing, and utensils and they depended on the products of the sea for food. Travel and transportation were mainly by water and they skillfully hollowed out giant cedar logs for canoes like the large Haida war canoe in the center of the hall.

Except for two tribes, the Shuswap and Thompson, who live in the interior of British Columbia, the exhibits are arranged in the order in which the various tribes are encountered in going from south to north along the coast of Washington, British Columbia, and Alaska. On the right side of the hall are the Bella Coola, Tsimshian, Haida: on the left, the Nootka, Kwakiutl, Tlingit.

The murals of Will S. Taylor depict not only the industries, religious and social life of these Indians, but also their heavily forested and fog-and-rain-drenched environment. The murals on the right side show ceremonials and religious life. On the left they show daily life and industries. Games are illustrated over the entrance and at the farther end of the hall, the return of a victorious war party.

They were also skilled in weaving with mountain goat wool and shredded bark and in making baskets. Notice the Chilkat ceremonial blankets a little over halfway along the hall, on the left, and the Tlingit baskets at the end. These Indians have likewise distinguished themselves in the carving of stone, bone, and ivory, examples of which are shown for the various tribal groups.

Outstanding perhaps is the wealth of decoration seen on all their products. The typical grotesque art motifs, based on the distortion of animal forms, are found in equal abundance on useful and ceremonial objects.

Eskimo

The Eskimo are often named as the primitive people who have made the most complete adjustment to their environment. They inhabit the northern shores and neighboring islands of North America, from easternmost Siberia and the Aleutians to East Greenland and Labrador. All these Eskimo, who differ somewhat in details of culture according to locality, are represented here, though not with equal completeness.

Contact with the white man has changed the Eskimo's way of life, but he continues to use many of his traditional tools, implements and distinctive articles of fur clothing. The Eskimo are hunters and fishermen. In summer they hunt the caribou, musk ox and birds, often inland. Their dwellings at this season are tent-like frames covered with caribou or seal skin.

In winter they hunt sea mammals, especially seals. Their winter houses are of stone built over shallow excavations and are covered with earth. The familiar snow house is the traditional winter dwelling of certain tribes but is unknown in Alaska and in most of Greenland. Models on exhibit show how the snow house is built. The Eskimo are skilled in the making of fur clothing and skin boats. The clever implements they make of wood, bone and ivory are often decorated with naturalistic cut-in designs. Many of the objects shown here are from the collections made by the Peary, Comer, MacMillan, and the Stefansson-Anderson expeditions.

Near the entrance of the corridor is an Eskimo woman fishing through the ice. She has made a windbreak with ice blocks. The fishing rod and hook and the long ladle are made of bone. She keeps the water from freezing while she is fishing by using the ladle to break and remove ice. In another case an Eskimo woman is cooking inside a snow hut that is lined with seal skin. She is using a stone lamp filled with seal oil which provides the flame for her cooking.

Indians of Mexico and Central America

At the west stairway on the second floor, we enter an alcove and a hall devoted to the ancient civilizations of Mexico and Central America. The alcove contains a series of small dioramas showing the varieties of climate and landscape in Middle America, a large series of gold and jade objects.

A Tobacco Pipe *designed and carved in the form of a whale by the Tlingit Indians of Alaska*

and pottery vessels typical of several of the culture areas into which Middle America can be divided.

Entering the central part of the main hall, one faces a cast of a gigantic stone head of the Olmec culture. Along the sides of the central portion are reproductions of some of the great carved monuments of the Maya sites of Copan and Quirigua, and a series of cases containing a number of the more beautiful objects in the Museum's collections.

Four of the alcoves along the right side of the hall are given over to each of the four major cultural periods in the history of the Valley of Mexico, the others to the Central Vera Cruz area, the Huastec area, the Maya, and the cultures of El Salvador and Costa Rica.

The left side of the hall deals with Western and Northern Mexico, with the cultures of Oaxaca and with a number of the major sculptured monuments of the Aztec of Central Mexico. The far end of the hall is Mayan, with several models of Maya buildings and two large cases containing examples of Maya sculptures. These original pieces are from Copan and from Northern Yucatan, the latter being all that remain from a collection made by John Lloyd Stephens, the "discoverer" of the Maya civilization early in the last century.

The walls and landings of the west stairway between the first and third floors exhibit reproductions of various Maya and Central American sculptures.

Cultures Represented: The material represented in this hall shows the history and cultural accomplishments of some of the more civilized peoples of the New World, sometimes referred to as those of Middle America or Mesoamerica. Within this area there were many local cultures, but all of them had characteristics in common which set them off as a unit distinct from the somewhat less highly developed cultures of North America, and both the lesser and higher cultures of South America. Several distinctive features of the Middle American cultures are the use of lime mortar in building and the existence of complex calendar systems and hieroglyphic or picture writing.

The higher Middle American cultures lasted for a period of nearly 3,000 years, so time is an important factor in any consideration of them. The following basic time schedule is generally applied:

15,000 B.C.-1,000 B.C. — *Period of Early Man.* Only meager remains of this earliest period have yet been discovered in Middle America, most important being the skeleton of Tepexpan Man, estimated to date from 10,000 B.C. No materials from this period are on exhibit.

1,000 B.C.-1 A.D.—*Pre-Classic Period.* Variously known as the Archaic or Middle Culture Period, this is represented by peoples living in permanent villages depending on farming, but without the great ceremonial buildings of later periods. Pottery-making and sculpture in clay were important.

Eskimo Woman Fishing through the Ice
(Group in The Eskimo Hall)

1 A.D.-900 A.D. — *Classic Period.* This is the great period of Middle American civilization, taking in the so-called Old Empire of the Maya and the Teotihuacan, Zapotec, and Totonac cultures of Mexico proper. It is the period of the great cities and many of the sculptured monuments shown in the hall.

900 A.D.-1520 A.D. — *Post-Classic Period.* With the close of the Classic Period, new and seemingly more militaristic orders were established, represented by the New Empire or Mexican Period in Yucatan and by the succeeding Toltec and Aztec dominations of Central Mexico. The period ends with Cortez's conquest of Mexico and the almost complete destruction of the native cultures.

Nature of Objects. It is impossible to present a well-rounded picture of the ancient Middle American civilizations, for, with rare exceptions, it is only the more lasting objects of pottery, stone, bone, shell and metal that have survived the destructive action of time and weather. Such things as the wooden drums of the Aztec are therefore great treasures. However, in our attempt to understand the life of ancient Middle America, we can rely heavily on the small number of native manuscripts in picture-writing that have been preserved and on the remarkably full accounts of native life written by the early Spaniards.

Architecture. The varied and imposing architecture of Middle America may be seen in the models and illustrations distributed around the hall. The buildings preserved are either temple structures built on pyramid-like platforms or are thought to be housing for the priests or persons concerned with the elaborate religious ceremonies. Ornate tombs are also important, the full-sized reproduction of one at Monte Alban being a good example of this architectural form. Little remains, and nothing is shown, of the ordinary living quarters, as these were apparently of wood or thatch, similar to those in use at the present time and just as impermanent.

Sculpture. It is in sculpture that we may best measure the tremendous attainments of the ancient peoples of Middle America. Their religions with their many gods required many images shown in a great variety of human and animal forms. These are often grotesque and hard for us to appreciate, but they are conceived according to universally accepted standards of beauty and are of high artistic quality. An early and important style is that seen in the Olmec sculptures, which range from the most delicate of jade carvings to the colossal stone head from southern Vera Cruz, mounted in the center of the hall. In the Olmec style, the human figure is presented with a suggestion of Negroid features, often in combination with those of the jaguar, an animal that played an important role in the symbolism of the early cultures. It is curious that the Olmec carvers, who seem to represent one of the earliest of the high cultures of Middle America, were the greatest masters in the carving of jade and produced sculptural forms most readily appreciated by us.

Upper left: Olmec Style Ceremonial Axe in Green Jade. *One of the largest and finest jades known.*

Lower left: The God Xipe-Totec. *This life-sized image of terra cotta shows the wearing of the skin of a sacrificial victim. From near Texcoco, across the lake from Mexico City, the figure dates from the Toltec period.*

Right: Aztec Corn Goddess. *This outstanding example of Aztec stone sculpture is notable for its simple naturalistic presentation. It was found in Ixtapalapa, a town near Mexico City.*

Left: Cast of Olmec Stone Head. *The original of this gigantic stone head lies in the jungle in southern Vera Cruz at the Olmec site of San Lorenzo.*

Upper right: Carved Slate Mirror Back. *The elegant design and the curvilinear motifs around the edge of the disc place this piece in the so-called Tajin culture of Central Vera Cruz. It is probably late Classic in date.*

Lower right: Scale Model of Maya Temple. *This temple is on top of a high pyramid at Tikal, Guatemala.*

Maya sculpture is more complex and appears to reflect an involved religious belief and ritual. The great skill of the native sculptors is apparent in the Copan and Quirigua stelae or tall stone slabs, where intricate detail is combined with the handling of enormous masses. Our respect for these ancient peoples is further increased when we realize that these great works were done without the benefit of metal tools.

Many and varied figures in baked clay also show a great technical and artistic ability. Especially interesting is the historical series of figurines from the Pre-Classic and Teotihuacan horizons of the Valley of Mexico. The succession of styles has been used by the archaeologist as a sensitive marker of culture change.

Writing and the Calendar. The highest developments of the art of writing in the New World were attained by the Maya. A number of examples of their picture-writing are found on the reproductions of the stelae and on other objects in the hall. A major portion of these texts concerns the statement of dates in the elaborate calendrical system brought to highest perfection by the Maya, but which was also used by the Zapotec, Aztec and other groups. However, most of the non-calendrical parts of the Maya texts remain undeciphered. Both the Maya and the Mexican peoples also painted their hieroglyphics in books of paper or leather known as codices. Only a few still remain from Pre-Conquest times.

Pottery. Vessels of baked clay are abundant in all collections from prehistoric sites in Mexico. Their interest is two-fold, in giving us a knowledge of the daily life of the native peoples and as one of the most important measuring devices in the study of the history of our area. The modern archaeologist relies to a large extent on the broken pottery found in the kitchen middens or refuse heaps of living sites. By carefully excavating and analyzing the changes in pottery types from the lower to the higher levels in these refuse heaps, he is able to estimate the changes of styles and of peoples through time and from area to area. An example of this method of reading history by examination of pottery layers is shown in the Huastec alcove on the right side of the hall.

Metals. The use of metals appeared late in Middle American history — at the beginning of the Post-Classic Period. The techniques of metal-working occur much earlier in South America and it is assumed that these arts were diffused northward into Middle America. Nevertheless, the gold-work of Mexico is considered to be of higher technical and artistic quality than any other in the New World.

Jade. Various kinds of semi-precious stones were used in Middle America for ornament or insignia, but jade was the substance most highly prized. The Middle American jades are classified as jadeite, but are distinct from the Asiatic types. Several styles of jade carving are recognized, the finest being those of the Olmec and the Maya, of which outstanding examples are to be seen in the alcove to the left of the entrance to the main hall.

Maya Pottery Bowl with Carved Decoration. *This bowl is a fine vessel from northern Yucatan, dating from late in the Classic Period.*

Musical Wind Instruments of Ancient Peru. *The wind instruments of the ancient inhabitants of Peru, as illustrated above, included the panpipe or syrinx shown in the center; resonator whistles (left); trumpets made of clay and wood; and a great variety of simple whistles. The pottery figure at lower left, showing how the panpipe was played, is a fine example of naturalistic pottery sculpture.*

Indians of South America

This hall contains Indian exhibits from all the South American countries except Uruguay. The largest portion of the exhibits illustrates the prehistory of the peoples of Peru and Bolivia and is arranged in the front of the hall.

Unlike the ancient peoples of Mexico and Central America, the Peruvians had no written language. They were tillers of the soil and raised potatoes, oca, quinoa, beans, coca and cotton. They domesticated the llama as a beast of burden and the alpaca as a source of wool. They excelled in the manufacture and decoration of pottery vessels, in metal work and in textiles.

Their gold and silver objects, such as beads, cups, pins, plates and ear ornaments, show a high degree of skill in the beating, soldering and casting of metals.

In weaving, the Peruvians were perhaps first among prehistoric peoples of the world, many of their textiles shown here being unsurpassed to the present day. The materials used were cotton and the wool of the llama, alpaca and vicuna. In the cases near the entrance are examples of these textiles and the fibers, spindles, threads, looms and other equipment used in their manufacture. At the center of the hall are beautiful examples of fabrics decorated with feathers. Some of the costumes in use at the time of the Conquest are displayed at the right of the entrance hall. To the left are complex embroideries made by the people of Paracas before the beginning of the Christian era.

On the right side of the hall are collections from important localities in Peru, followed by exhibits from Ecuador, Colombia, Venezuela, Brazil and Panama. In Case 57, near the center of the hall, selected pieces of pottery show the different forms and decorations which distinguish the various important cultures of Peru and Bolivia. As far as our present knowledge permits, the changes which occurred in the course of time are also indicated. Each of these cultures is shown in greater detail in individual cases.

Outstanding is the beautiful work of the Nazca people who excelled

Pottery of the Mochica *or Early Chimu Period. A warrior in full regalia is shown on the vessel at the left. In his right hand he holds a mace; in his left, a shield, spear-thrower, and javelins. The right-hand piece is a "portrait" jar.*

Nazca Pottery. *By far the most skillful use of color in Peruvian ceramics is seen on such specimens as these. As some of the mythological beings depicted also appear on earlier Paracas embroideries, a cultural continuity of the two periods is indicated.*

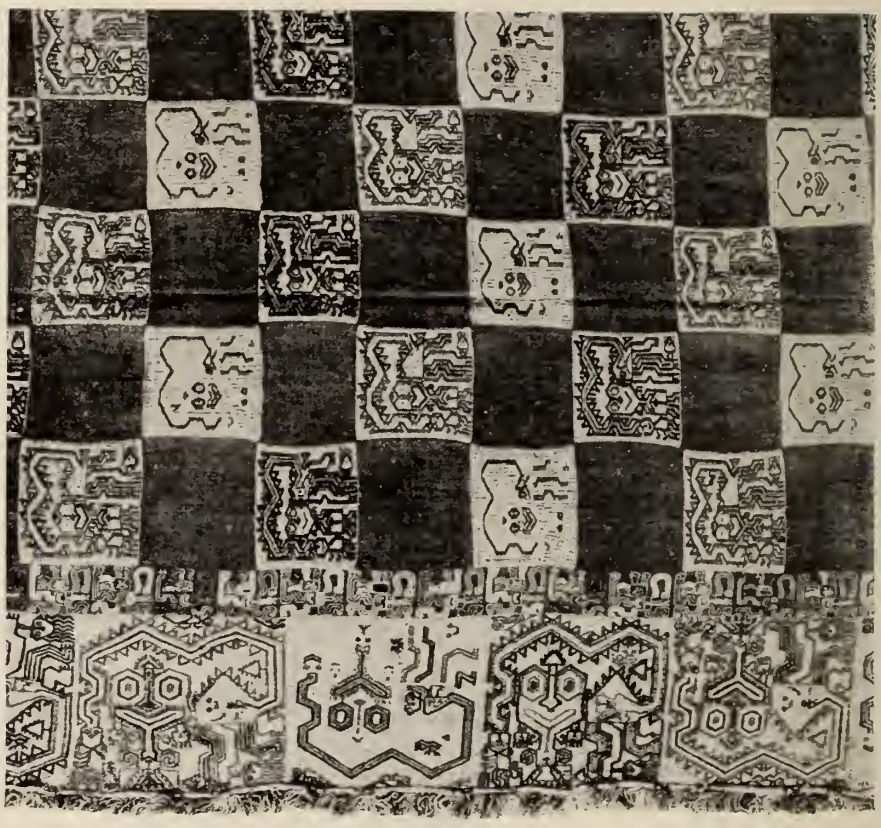
among all American potters in their use of color. This display is arranged to show the wide representation of mythological creatures, birds and animals, with one section devoted to the differences which distinguished two separate traditions in their motifs.

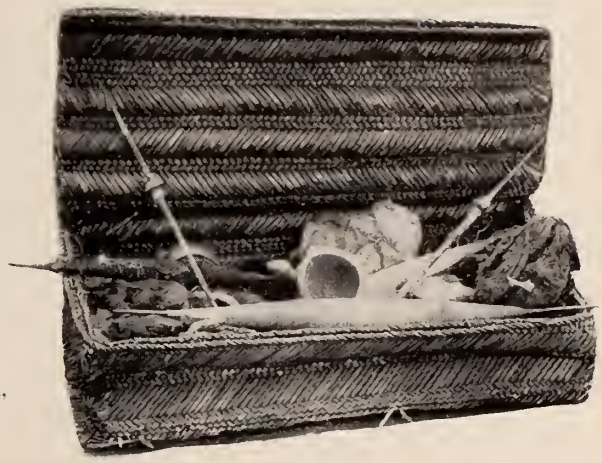
In special exhibits are grouped such things as musical instruments, whistling water jars, examples of intentionally deformed human heads and trephined skulls showing the successful practice of a delicate surgical operation by the ancient Peruvians.

Much of our knowledge of their daily life we owe to a fortunate combination of climatic conditions and tribal customs. Along the coast of Peru, where the extreme dryness of the climate has preserved perishable materials for centuries, are more extensive burial places than anywhere else in America. Countless thousands of bodies were buried with such things as had been most useful and prized during life or were considered to be most serviceable in a future life. Examples of these mummy bundles are displayed, and it was from such as these that many objects in the hall were obtained.

The mummy in the case at the west side of the room was found in a copper mine at Chuquicamata, Chile. The body is that of an Indian miner who was killed by the falling of rocks and earth while he was getting out the copper ore (atacamite) used by the Indians in making implements and ornaments in prehistoric times. The tissues of the body have survived in better condition than is usual in naturally mummified bodies. The tools he was using at the time of his death are lying beside him in the case.

Much more primitive than any of the prehistoric people just mentioned were the nomadic hunters and fishermen who lived in the southern end of the continent and the neighboring islands. Their story from the time when they hunted the extinct native American horses and ground sloths, about nine





Top left: Paracas Embroidery. *A fine example of highly conventionalized treatment of a cat figure.*

Bottom left: A Peruvian Tapestry. *An excellent tapestry from Pachacamac, Peru, with slits left open between color areas as part of the design.*

Right: A Peruvian Woman's Work Basket, *with carded fiber, spindles, bobbins, and other weaving equipment.*

to ten thousand years ago, was recovered from caves and shell mounds. The simple tools and weapons they used are arranged in time-order in a case in the rear of the hall. Near by are examples of the equipment of the various tribes still living in the same region at the present time.

In neighboring cases are exhibits for other living Indians of South America. As there are a great many distinct tribes, sometimes living in widely different geographical areas, the collection is far from complete. An example of native life in the tropical rain forest of northeastern Peru is shown in a miniature group of the Montaña Indians. They raise plantains and cassava and hunt small game, so their equipment is naturally specialized for these occupations. This latter exhibit is temporarily on display in the ***Men of Montaña Hall.***

MEN OF THE MONTAÑA

In the dense tropical rain forest of eastern Peru live several related tribes of primitive Amazonian Indians. Their homeland, called the Montaña, stretches eastward from the cloud-covered slopes of the Andes, a region of rugged mountains and swift-flowing streams. The rain forest, the mountains, and the rapids have isolated tribes from one another and limited the areas suitable for habitation.

In spite of the lush vegetation, soils are poor for farming and game is scarce. Animal and human enemies lurk on every side. Until the rubber boom brought the white man in numbers at the turn of the century, these tribes lived much as they had before the discovery of the New World.

This exhibition tells the story of primitive man's adaptation to life in a hostile and difficult environment — the Montaña of the Amazon headwaters. Throughout the hall, an attempt has been made to suggest the environment through the use of appropriate colors, lighting, and more especially, sound effects native to the region. By means of two phonograph records played continuously through six amplifiers, the atmosphere of the rain forest is

recreated, and the exhibits may be viewed against a background of authentic jungle noises which include the cries and calls of monkeys, parrots and toucans, toads, and insects.

At the entrance of the hall, beyond an open exhibit of a Cashibo warrior in a forest setting, are a series of five cases comparing artifacts from the Montaña with others from the Andes and the lower Amazon. The point is made that while the Montaña is situated geographically at the very foot of the Andes, the culture of the Montaña tribesmen is much more closely related to that of the lower Amazonian Indians, 1500 miles or more away to the east.

To the left is a series of exhibits illustrating tropical forest agriculture. The Montaña Indians farm by the so-called "slash and burn" method, felling the jungle to plant manioc and other root crops, plantains, corn, beans, squashes, and cotton. In addition to farming they hunt wild game with highly specialized arrows, with blow-guns and poisoned darts, and with traps. They also fish the lagoons and rivers with bow and arrow and harpoon, all of which techniques are illustrated in the center of the hall.

Until recently the Montaña tribesmen were very warlike, and consequently devoted considerable attention to the manufacture of spears, clubs, bows, and arrows. Some groups, like the Jivaro, cut off the heads of their enemies and shrank them to the size of an orange.

The decorative art of the Montaña is well developed and sophisticated. Design motifs consist of complex geometric figures painted upon pottery and textiles, engraved upon wood and bone implements, and woven into beadwork. The same design elements are used on all objects, and are even painted on the faces and bodies of the Indians themselves.

The Montaña tribesmen manufacture ornaments from a large variety of materials. They make crowns and diadems of feathers, earrings of beetle wings, collars and bracelets of teeth and claws, and a varied assortment of necklaces from the seeds and nuts of tropical plants. In addition to painting their faces, they perforate their lips, noses, and ears for ornaments, and artificially flatten their heads. These unusual modes of personal adornment are illustrated at the far end of the hall. Here also are shown the recreational activities of the Montaña Indians, including their musical instruments, tobacco pipes, and children's toys. The exhibit concludes with a case illustrating the ceremonial life of these people, which centers around rites held for adolescent girls.

Left: Cashibo Warrior. *The use of the bow and other weapons is taught from early childhood.*

Right: Panoan Girl. Men of The Montaña. *To celebrate her advent into womanhood, she is painted, stupefied with drink, and subincised by the older women. The ceremonial feast that follows may last as long as ten days.*

Easter Island Statue. *Easter Island, in the South Pacific, is famous for the immense stone statues found there, from one of which a Museum expedition made the cast here illustrated.*

The Pacific

Two halls, fourth floor, are devoted to the peoples of the Pacific Islands and of Australia. The first, ***South Pacific Hall,*** contains collections from Polynesia, Micronesia, Melanesia, New Guinea and Australia. Polynesia, as represented by the Maori of New Zealand, extends into the second hall, which is principally devoted to exhibits from the Philippine Islands, small special exhibits from New Guinea, and special collections from Java, Sumatra and Borneo.

The most conspicuous objects in these halls are the Easter Island statue, the models of Tahitian and Philippine life, including a Philippine tree house, the collection of tattooed heads from New Zealand, and the collection of masks from New Ireland.

On entering the South Pacific Hall, beyond the Hall of Minerals, on the fourth floor, the visitor sees a huge stone face, a cast of one of the famous Easter Island statues. This was brought back in 1935 by the Templeton Crocker Expedition. These statues are unique to Easter Island. They were found set on stone platforms all around the island. Their origin and exact meaning are unknown.

Directly in the center of the hall is a Tahitian priest taking part in the fire-walking ceremony, in which the participants walk over heated lava boulders. On each side is a group showing natives engaged in typical activities — grating coconut, preparing kava or plaiting pandanus.

Just behind the Easter Island statue is a fine Hawaiian feather cape, such as was formerly worn by the highest ranks of the Hawaiian society. Red and yellow honeysucker feathers, which were collected as taxes, were fastened on a netted twine foundation. The value of these garments depended on the enormous labor spent on their making.

The hall is roughly divided into two main sections. In the first half are shown the collections from Polynesia and Micronesia, while the second half is given over to New Guinea, Melanesia and Australia. However, it proved impossible to be wholly consistent and to separate Melanesian Fiji from Samoa and Tonga.

In the ***Polynesian*** section, the examples of decorated native bark cloth (tapa) are especially noteworthy, and a number of canoe models remind us that these people are daring seafarers. A series of ceremonial adzes from the Cook Islands in the farther quarter of the hall shows aboriginal carving at its best.

In the section on the right, the elaborately carved sacred masks, about 14 feet back of the Tahitian fire-walker, illustrate the type of carving characteristic of the Melanesians of New Ireland as do the two delicately carved poles against the west wall.

Another beautiful and distinctive style is found in the carvings of the Maori of New Zealand, where a spiral motif is dominant. The series of dried and tattoed heads forms one of the most remarkable exhibits in the Museum.

Left: Mask, Tchambuli, *Sepik District, New Guinea*

Middle: Carved Wooden Hook *Used in Decorating Men's Houses in Tchambuli, New Guinea*

Right: A Section of a Manus (Admiralty Islands) Village. *reconstructed with scientific accuracy in every detail; one of many miniature models in the American Museum showing native home life and activities.*

Near the boundary between the two main sections are the ***Australian*** cases with numerous boomerangs and very crude stone tools, which should be compared with those in the archaeological hall. The farther corner contains a collection from the Admiralty Islands, including a model of a village of the Manus tribe, a lagoon-dwelling, fishing people who build their houses on piles far from land. In the right corner of the hall are shields, clubs, carvings, and household utensils from New Guinea.

The islands of the Pacific Ocean may be divided into two types: the high islands which represent remnants of sunken land masses or else the result of volcanic action, and the second variety consisting of low coral atolls rising not much more than 20 or 25 feet above the sea. The environments that these islands provide for their inhabitants are strikingly different and have affected the kind of life they are able to lead.

The high islands are, for the most part, fertile and well covered with a variety of vegetation. The coral atolls have little or no soil and support a very thin plant life. Although both high and low islands occur in various parts of the Pacific, there are two principal areas where the coral atolls are specially concentrated: one is in Micronesia and the other in the Tuamotu chain of Eastern Polynesia.

The people who live in these various islands belong to a number of different stocks. The Polynesians occupy the easternmost islands and differ significantly from the dark-skinned frizzly-haired people of Melanesia on the one hand and from the short, more Mongoloid type found in the Micronesian islands.

Culturally, these three major island groupings also show differences that

suggest, to a large extent, independent histories. The Polynesians manufacture bark cloth and matting, have no pottery, drink kava, fight with clubs, and are skilled navigators. They are governed by chiefs who trace their ancestry back many generations. The Melanesians make some pottery, do grotesque carvings, use bows and arrows and spears for hunting and fishing. They have men's cults into which boys are initiated and from which women are rigidly excluded.

The Micronesians live on the chain of small islands extending south from Japan to Melanesia. They are characterized by a complex political organization, great skill as navigators, and a simple food economy based on the sea.

The peoples of the New Guinea mainland and the interior of some of the larger islands of Melanesia can be grouped together as land peoples, speaking complex or non-Melanesian languages.

The aboriginal inhabitants of Australia had one of the simplest technologies to be found in the contemporary world. A hunting and food-gathering people, their tools and weapons had to be carried with them, and almost all the elaborations of their culture were expressed in songs, dances and complicated marriage patterns which cannot be shown in Museum cases.

Collections from the Philippines and Malaysia

This hall is reached by turning right in the South Sea Island Hall.

The side aisles display Philippine Island objects. The farther section of the hall contains exhibits from other parts of Malaysia with an interesting series of marionettes from Java.

At the right of the entrance is a case containing life casts of faces, noses

Philippine Tree House

and hair from the different races represented in this hall, also charts of stature and head form, with distribution maps.

In the center is a model of a Filipino bamboo-walled and thatch-roofed house. At the far end, a native tree house dominates the scene, and on the left may be seen the model of a woman weaving a garment on a native loom.

The visitor should note that, like the African Negroes, the Malayan tribes represented in this hall use iron tools. The numerous iron weapons — spears, battle-axes, and krises (daggers with serpentine blades) — are especially remarkable.

On the left side of the hall are found a number of exhibits of native krises, shields, fabrics, basketry and pottery. Pottery is not highly developed in this area, but the textile arts flourish to a remarkable degree. The industrial life of the Bagobo of Mindanao is particularly well-illustrated in the collections.

Much more primitive in their culture than the other Malaysians are the Negritos, a dark-skinned and frizzly-haired pygmy stock forming, with like groups in other parts of the world, a distinct division of the Negro race. They

are everywhere hunters, using the bow and arrow, and ignorant of agriculture. Their simple tools are shown in a table case in the farther section of the hall.

The islands lying close to the coast of Asia have been subjected to several migrations and to varying cultural contacts. The present population is predominantly Malay in origin, members of the great Mongolian race. Their cultural arts include pottery, metal work and textile. The metal work is especially fine in the weapon-making of Java and among the Mohammedan inhabitants of the Philippines. Among the textiles are exhibited the batik work of Java, the tie-dyeing of the Bagobo in the Philippines, and fine textiles of Luzon.

They possess fowls and pigs, grow rice, and use the carabao, or water buffalo, as a domestic aid in farming and transportation. Their form of the widespread Pacific canoe type usually has a double outrigger. Their weapons are blow-guns, bows and arrows, spears, and knives. In parts of Melanesia, head hunting was formerly practiced and formed a striking cultural feature in this area.

Although the Malay culture has deeply influenced all the peoples of the area, influences from India and China have also been felt here; the former affecting thought and philosophy, and the latter furnishing, through commerce, cherished objects of art and use. More recently, Mohammedanism has entered the islands and has become the prevailing religion in some of them. About 300 years ago, Christianity and European culture were first introduced by the Dutch and the Spaniards.

Asiatic Cultures

At the entrance to this hall on the third floor is a section to the right given to a brief exposition of the prehistory and early historic periods of Japan. The exhibits on the left side illustrate in the main the life of the Chinese at the turn of the century when the bulk of the collections was made, so that many of the objects shown here no longer have a function in Chinese life. Bamboo, porcelain, basketry, inlaid work, cloisonne enamel, lacquer, farming implements, carvings in wood, ivory and stone, costumes, and embroidery are shown to advantage. Several technological processes are shown in detail, such as cloisonne and the history of printing.

In the wall cases to the left of the entrance is a collection of ancient Chinese bronzes, and adjacent to the tower at the left is the Whitney collection of Lamaistic ritual objects from Tibet, supplemented by costumes and household utensils used in daily life by the Tibetans.

Next to these is a series of the Vedic and Puranic gods of India.

The way of life of the island Asiatic peoples — Japan, Ainu, and Korea — is shown in the west end of the hall. Of particular interest are the two models of Japanese dwellings, an example of Japanese armor and No drama masks.

Other peoples represented are some of the tribal groups such as the Meiteis and Maring of the Assam-Burma region and the Chin and Kachin of the Upper Chindwin River, Burma.

The right side of the hall is occupied by the Chukchi, Koryak, Tungus, Yakut, Lamut, Yukaghir and Gold, all of whom live in Northeastern Siberia including the Kamchatka Peninsula. The Koryak, for example, are related in language to the Chukchi and Kamchadal, with whom they share many cultural attributes. Like the Chukchi, they are divided into a Reindeer and a Maritime branch, but differ from their neighbors in the almost exactly equal size of these divisions. The Reindeer Koryak live mainly on the flesh of their herds. The Maritime group depend largely on fishing, while the hunting of sea mammals is also important but relatively less so than among the Maritime Chukchi. The Reindeer people live in movable tents. The stationary, partly underground house of the Maritime division is illustrated by a model. Both divisions of the Koryak wear clothing made of reindeer skins.

Before contact with other peoples, the Koryak had no metal and made all their implements by chipping stone. Several settlements were noted for their iron technique, which may antedate the coming of the Russians, since the Tungus and Yakut were both familiar with the blacksmith's art.

The dressing of skins and the weaving of baskets by the coiled and twined methods are important industries. Remains brought to light by excavations of old dwellings show that the ancient Koryak knew how to manufacture pottery. The Koryak have attained a high degree of perfection as carvers in wood, antler and ivory, and in the skillful handling of furs in the manufacture of their clothing.

Drummond Collection of Jade

The famous Drummond Collection of carved Chinese jade, amber, Japanese ivory, and sword-guards is in the Southwest Tower on the fourth floor, opening out of the South Sea Island Hall. This magnificent collection gathered by the late Dr. I. Wyman Drummond and presented to the Museum in his memory, is installed as a unit, largely according to Dr. Drummond's original arrangement.

Left: A Pair of Chinese Bronze Horses. *They may have represented the horses of a chariot which has been lost. Ts In Dynasty.*

Right: Koryak Man In Armor

Upper left: Example of Chinese Cloisonne *from the Chinese Collection*

Upper right: An Emperor Birthday Gift *fitted together from purest white jade*

Japanese Ivory Figurine, *delicately carved*

Ivory Handled Iron Weapons of the Mangbettu. *The great sickle-shaped knives were worn over the shoulder by the king and the other prominent men when they were sitting in council, partly as proof of the wearer's readiness to strike.*

It is really a group of collections, each one of the greatest importance and beauty. The ***Jade Collection*** alone is a rich and well balanced series, representative of all periods and covering a cultural range of more than thirty centuries. The left half of the room is devoted to jade arranged by periods, while the right half is given over to ***Amber, Ivory, Lacquer,*** and ***Bronze Sword-Guards.*** The oriental amber displayed is the finest of its kind in the world.

A unique composite piece of white jade, occupying the center of the room, was a birthday gift to the Emperor Kien Lung from the officials of his court. This assemblage of jade carvings consists of thirteen pieces fashioned

from purest white jade and fitted together. Surrounding the central piece are twelve segments fitted together, each of which is carved with a representation of one of the twelve terrestrial branches corresponding to the signs of the zodiac.

A very fine piece of white jade of the Kien Lung period of renaissance in glyptic art is in the form of a "Scepter of Good Luck" (Joo-i scepter). On the long handle of this piece are carved in high relief the figures of the Eight Immortals, the half-mythical, half-historical personages so often represented in Taoist art. Each of these carries some characteristic object, such as the flute of Han Hsiang-tzu, whose marvelous tone caused flowers to grow and blossom instantly.

African Cultures

The order in this hall, third floor, is roughly geographical. Thus, as the visitor proceeds through the hall, he meets the tribes that would be found in passing from south to north in Africa. The West African peoples are represented along the left hand wall, the East African along the right hand wall, and the tribes of the Congo around the central rectangle.

Nothing is more characteristic of the Negro culture than the art of smelting iron and making iron tools. The process used by the African blacksmith is shown in a group on the left at the entrance and the finished products, such as knives, axes and spears, are amply displayed throughout the hall. The knowledge of the iron technique distinguished the Negro culturally from the American Indian, the Oceanian and the Australian.

A pictorial map indicates the various culture areas distinguished on the continent. Clothing is either of skin, bark cloth, or loom-woven plant fiber. The manufacture of a skin cloak is illustrated by one of the figures in the group to the left of the entrance. Bark cloths from Uganda are shown in the farthest right-hand section of the hall, while looms and the completed garments are on view in the large central rectangle given over to Congo ethnology. The most beautiful of the last-mentioned products are the "pile cloths" of the Bakuba, woven by the men and supplied with decorative patterns by the women. Very fine wooden goblets, fetish figures, masks, and especially a series of ivories from the Congo, bear witness to the high artistic sense and craftsmanship of the African natives. The importance of musical accompaniment to their ritualistic dances is demonstrated by the great variety of musical instruments.

A unique art is illustrated in the Benin case in the farther section of the hall where the visitor will see bronze and brass castings made by a process similar to that used in Europe in the Renaissance period.

The religious beliefs of the natives are shown by numerous fetishes and charms, believed to give security in battle or to avert evils. Ceremonial masks are shown, which were worn in native rituals.

Bronze head *of a woman, Benin tribe.*

BIOLOGY OF MAN HALL

As this guide is being prepared, a reorganization of various anthropology exhibits is underway. The first major revision will be installed in the Old Eastern Woodlands Hall which is the first one to the west of the Seventy-seventh Street Entrance. This is intended to be the initial section of an integrated sequence of exhibits that will eventually occupy five connecting halls on the first floor and cover systematically the origin and biology of man, the fundamental aspects of behavior, social structure, development of culture and civilization. and the history of man in the United States. The material now on view in these halls will eventually be reinstalled in the upper floors.

About the time this guide is issued, or shortly thereafter, the first hall of this new sequence will be opened to the public. It will have a three-part arrangement. In the introductory area, the exhibits will emphasize man as a zoological species. As a form of organic life. ***Homo sapiens*** represents a particular pattern of adaptation that can be understood as an outgrowth of a long series of the successive adaptations which we call evolution. Beginning as perhaps single cells a couple of billion years ago. organic life has by its increasing complexity and specialization been able to make use of an ever widening variety of environmental niches. Some of the forms that have appeared during this long period of time have been replaced by others. perhaps more adapted to the environments they were occupying. or have become extinct when their environments were modified beyond their powers

of adjustment. Those that have survived, together with the newer adapted forms, make up the present highly varied array of organic life by which we are surrounded. The story of all this, as far as we know it, is, however, too vast to be set forth in this hall where our concern is primarily with the human organism. But some part of it must be understood if we are to appreciate man's position in the organic world.

To comprehend the chronological relations of human life to life in general, a time scale is provided in the exhibit. The earliest man-like creatures, called "hominids" in scientific literature, are at present considered to have first appeared in the Pleistocene period. This is the latest geologically distinct period if we may overlook the Holocene, or recent — the one we are living in now — on the ground that the Holocene may well be simply an extension of the Pleistocene. Although true hominids may not have evolved by the very begininng of the Pleistocene, the existing fossil record certainly suggests that that event must have been near its commencement. In round figures, therefore, man as a zoological category may be a million years old. This, against the currently estimated age of organic life on the earth, is only 1/2000th at most of the time since life began. It might well be an even smaller fraction. Man, therefore, has had a relatively short history as organic time goes.

Associated with this time scale, a series of exhibits analyze the morphological and zoological affinities of man with other vertebrates and indicate the general path of human evolution from the fishes. His classification as a vertebrate, a mammal, and finally a primate (monkeys, apes, and man) on the basis of his structure is demonstrated.

The evolution of a tree-living primate to a bi-pedal hominid is demonstrated in terms of adaption to upright posture, enlargement of the brain, and the tool-using hand. These dynamic factors underlie the evaluation of the fossils that mark the path of hominid evolution, and the meaning of the morphological details of hominid fossils may thereby be understood. Casts of the critical fossils are presented in this context in the hope that they will be more significant than they are when merely arranged in ascending order.

Having presented the outline of the history of the emergence of man as a distinct species of organic life, the exhibit takes up in the second section of the hall the way a human organism is organized and functions. A full exposition of this would be nothing less than a complete anatomy and physiology of man. Obviously this would have required many times more space than was available, assuming that all aspects of human physiology could have been demonstrated. The exhibit, therefore, is selective, but the selection was based on the premise that a carefully chosen series of three-dimensional demonstrations of fundamental structures and functions would give the visitor a real insight into the economy of the human organism. In many instances the exhibits are designed to get down to the microscopic levels where much of the function occurs. This is achieved by enlargements and

Birth of a Baby. *One of a series of Dickinson models in the Hall of the Biology of Man, opening soon. This model shows the birth of the baby's shoulders. Breathing is about to begin.*

by analytic displays. Movement, as in the beat of the heart and the passage of the ovum down the fallopian tube to the uterus, has been introduced to clarify some of the processes. And a wide variety of other techniques has also been adopted to demonstrate function as clearly as possible.

Since structurally and physiologically the cell is the fundamental unit of the body, which is made up of several billion of them, the initial exhibit is a demonstration of the structure of a generalized cell. Rendered in eight layers of carved lucite and illuminated along their edges, this much enlarged model demonstrates its highly complex organization which, in nature, is too small to be seen by the naked eye.

The modification of cells for special functions — nerve cells, bone cells, epithelial, etc. — is shown in carefully prepared enlargements. The arrangement of cells in tissues follows.

The reproductive cells, their genesis and control by the reproductive system, are illustrated next. This section continues with an exhibit on the process of reproduction, the development of the embryo, and birth.

In succeeding cases the other processes of the body and their roles are illustrated. These include the circulatory, respiratory, digestive, renal, nervous and endocrine systems, the muscles, the skeleton and locomotion, the sense organs and growth.

In the final section of this hall on the Biology of Man, the exhibits deal with what might be called group biology and man's relation to his physical environment. These aspects of human biology reflect the fact that human organisms live in groups and are affected directly by their milieu. Genetics, for example, can be conveniently shown here, not only in its mendelian form by familial examples, but also as population genetics. The phenomenon of variation and its classification by race and constitutional types form part of this display. Similarly the dynamics of demography find a place here as part of group biology. Morphological variations correlated with environmental differences and diet are dealt with and the vectors of disease that develop from the concentration of population, among other topics, are also used to illustrate this phase of the story of man as an organism.

general ecology

general ecology

Plants and animals live virtually everywhere on the face of the earth, on land and in water, from the peaks of the highest mountains to the depths of the oceans. But while life is widely distributed horizontally, it is limited to a narrow vertical zone, primarily within a few feet of the earth's surface. The number of living things decreases rapidly with depth in water or soil and with height in the air.

While most plants and animals are concentrated in a very narrow portion of the earth, they are not haphazardly distributed there, but occur in organized, smoothly functioning biotic (plant-animal) communities. Ecology is the branch of science that concerns itself with these biotic communities and with the interrelations of living organisms and their living and nonliving environment. Ecology seeks an understanding of (1) the factors which control the composition, structure, and distribution of biotic communities; (2) the internal functions of biotic communities; (3) the life history of each plant or animal member of a community; (4) how each member is adapted to life in the community; (5) what the relation of each member is to every other member of the community; and (6) what contribution each member makes to the welfare of the whole community.

In every region differences in direction of exposure, elevation, drainage,

character of the soil or underlying rocks, and the impact of natural or human-induced disturbances produce a series of biotic communities. The fundamental organization of all biotic communities, however, is everywhere the same.

The primary members of the biotic community are green plants which are capable of synthesizing simple foods. To accomplish this synthesis, green plants must obtain carbon dioxide and water from their environment and energy from sunlight. The products of this synthesis (photosynthesis) are sugar molecules, comprised of atoms of carbon, hydrogen, and oxygen bound together by transformed solar energy. A portion of the energy contained in this food is used by the plants to form more complex substances in which are incorporated the atoms of additional elements, such as nitrogen, phosphorus, sulphur, calcium, and potassium. From these complex substances, the various tissues of the plant bodies are formed.

The products of green plants serve as a source of food for the community's plant-eating or herbivorous animals. Because most herbivores are rather specialized in their diet, the average community has many different species, each species with a slightly different way of life — or, as the ecologist might say, occupying a different niche. In the animal, through the process of digestion, the various plant products are chemically altered so that they may provide the organic building blocks from which the tissues of the animals are fashioned. Equally important is the energy that these plant products make available to animals through the process of respiration. In respiration, the food obtained from plant substances is combined with oxygen and the energy stored in it is released. It is this energy, originally derived from the sun, that makes life possible for animals.

The organization of the biotic community is still more complex. There are, in addition to green plants and herbivorous animals, three other main groups of organisms, the carnivores, the parasites, and the saprophytes.

Carnivores — flesh-eating animals — obtain their supply of plant-originated food materials second-hand; in other words, rearranged into the meat, fat, or blood of the herbivores upon which they prey. Carnivores that prey largely upon other carnivores may be said to obtain their supply of solar energy and organic building blocks third-hand. In many of the more complex biotic communities the steps are carried still further, and food chains with five, six, or even more links are not uncommon. However, a great deal of energy is consumed between successive levels of feeders just in obtaining and digesting food. Therefore, a large quantity of plant material is necessary to ultimately support one animal at the end of a long food chain. A community can sustain but few individuals of such a species.

The fluids and tissues of animals and plants at all feeding levels may provide nutriment for various parasitic organisms. The waste products of living organisms and the bodies of dead organisms serve as a food source for the last level in the food cycle of the community, the saprophytes.

Saprophytes transform complex materials into a simple form which is again available to green plants as a raw material.

Man lives either by exploiting natural biotic communities for products he can use or by destroying them and substituting artificial communities that are more productive in terms of his specialized needs. An example of the latter is farming. We either directly harvest the plants for human use or utilize tame herbivores like cows and chickens to harvest them and to turn them into products we can use. Farmers regard most wild herbivorous animals as potential competitors. To keep their numbers to a minimum, wise farmers encourage predators like the insect-eating songbirds, moles and skunks, and the rodent-eating weasels, snakes, hawks and owls. If conflicts arise because chickens and other domestic animals are also attacked, it is often wiser to give such livestock better protection than to kill the offending carnivore and lose its help in reducing the damage caused by crop-eating wild animals.

Conservation is often called applied ecology, because we must first understand how biotic communities live and function if we are to manage them wisely. It is therefore one of the Museum's chief interests to make better known the natural laws to which man must conform if he wishes to exploit land or a natural community without impairing its future productivity.

As students of natural history we are also interested in the preservation of samples of every natural biotic community that is native to this continent. Only if we are successful in this, will coming generations have an opportunity to study and enjoy all the forms of wildlife now native to North America.

Stissing Mountain Scene. *A landscape is a complicated mosaic of distinctive plant-animal community units.*

FELIX M. WARBURG MEMORIAL HALL OF ECOLOGY

In Warburg Hall we visit Pine Plains, a typical rural area in Dutchess County, N. Y., ninety miles north of New York City. Here we can learn something of its geological history, of its natural biotic communities, and how the rather recent arrival of man has influenced them. We can see the story of man's attempts to exploit the land by establishing artificial communities and how nature replaces these with wild communities when man, because of his failure to maintain soil fertility, abandons further attempts at cultivation. Within a few steps we can explore a typical landscape and learn a few of the basic principles of life on our earth.

An October Afternoon Near Stissing Mountain. Stissing Mountain, a mass of hard rock called gneiss, is the most commanding feature of the Pine Plains' landscape. Here Stissing Mountain is seen in the brilliant autumn colors that are one of the outstanding attractions of the hardwood forests of northeastern United States. Here, too, are a few of the animals that form an integral part of the community — the blue jay, red fox and dragon fly.

Bird's-Eye View of Stissing Mountain and Village of Pine Plains. This 3-dimensional map shows the Pine Plains area as it appears today. Its patchwork of fields and forests is typical of most agricultural communities in the glaciated Northeast. Local variations in direction of exposure, soil texture, drainage, nature of underlying rock, and proximity of water table, control such a pattern and are subject matter of this Hall.

Geological History and Structure. The present mountains and valleys of Pine Plains are the product of many millions of years of weathering, rock formation, and earth movements that have folded and fractured, submerged and elevated the landscape. Here are displayed the various kinds of rocks that are now exposed at the surface and some of the forms of life that lived here when these rocks were being formed.

Glaciation. Recently — geologically speaking — a great mass of ice moved down from the north over this area. As it moved, it scoured away soil and smoothed rocky ridges. Portions of the ridges were broken to form boulders; other portions were ground to claylike fineness. Slowly the ice melted, leaving behind a rolling landscape of hills and marshes, ponds and lakes. Due to the action of the glacier, there are now pockets of clay soil in one place, stony ones in another, and little or none on the exposed ridges around Pine Plains.

The Water Cycle. The course that rain water takes after it falls on the soil is indicated in a model cross-section of a rural landscape. The relation of wells, springs and flowing streams to the underground zone of saturation is indicated. The sloping land on the right has been subjected to erosion by water due to improper farming and will no longer yield a living to the owner.

Soils and Soil Conservation. Weathered rocks, glacial debris, and water-laid beds of sand and clay provided the raw materials for the area's

The Water Cycle. *Water running downhill creates problems above ground, but is an asset below ground.*

soils. As these materials were leached and the remains of plants and animals became mixed with their surface layers, soil was formed. Because of their diverse origins, sandy and clayey soils, or loam soil, which is intermediate, all occur within relatively small areas at Pine Plains.

Life in the Soil. Beneath our feet there is a subterranean world that teems with life. Here many insects spend part of their lives. Earthworms and hundreds of smaller animals feed on plant and animal remains, converting them into humus. Moles literally swim through the soil with the help of their powerful feet, leaving tunnels that provide runways and homes for chipmunks, mice, toads and insects.

Roots in the Soils. The parts of a plant that occupy the soil are no less important than those that extend upward into the air. Here you see an enlarged portion of a root and its absorbing root hairs. A magnified soil section shows such a root hair pushing through the air and soil solution that occupies the spaces between the soil granules.

The Relation of Plants to Geology and Soil. In glaciated areas like Pine Plains much of the underlying rock is covered by deposits of glacial debris that may have been carried many miles. Soils derived from such material show little correlation with the underlying rock. On the higher areas the soil that once covered the rocks was scraped away. Now, since the retreat of the glacier, weathering is slowly creating raw materials that plants are turning into soil. Immature soils of this sort vary greatly, as they are strongly influenced by the rock from which they have been derived. Usually, a few plants are adapted only to the conditions in a given soil type and they serve as indicators of that type of soil. Here are samples of four soils derived from four of the area's rock formations, together with a few of their plants. We also see two lowland areas where an excess of lime has created what are for this region most unusual environments.

Below Ground View In Winter. *The hibernating chipmunk sleeps out the winter, but the deer mouse must forage nightly for food.*

Rotation of Farm Crops in Dutchess County, N. Y. Here are dioramas showing the appearance of the local crop-land in early June, mid-July and early October. Here, also, are samples of some of the common cultivated grasses — wheat, oats, rye, barley and timothy — and various stages in the development of bean and pumpkin plants. By changing from year to year the type of crop that is grown, the humus content and fertility of the soil can be better maintained.

The Apple Orchard in Dutchess County, N. Y. Apples are the most important tree crop of Dutchess County. Here we see an orchard in bloom, during the spraying of trees, and at harvest time. Enlarged models show the steps in the fertilization of the blossoms by bees and in the life history of the codling moth that causes so many apples to be "wormy." Spraying to kill insect pests results in the destruction of both beneficial and harmful forms. After spraying, honey bees are often brought to the orchard to replace those killed by the spray.

Lime-Loving Plants. *Weathering limestone counteracts organic acids and produces the neutral soil needed by these orchids and other plants.*

Fertilizers in the Soil. Here two sods illustrate the difference that the application of needed fertilizers can make in the growth of pasture grasses. A model shows the appearance of the root of a legume (member of the pea family) with its nodules containing bacteria that convert atmospheric nitrogen into a form usable by plants. As other nutrient elements, if lacking, must come from fertilizers, some of their common sources are indicated.

Cycle of Nutrition and Decay. This exhibit deals with photosynthesis and the circulation within a community of the inorganic nutrients that green plants use as raw material in the manufacture of food. It points out how first plants and then animals use these substances as a source of energy and material for the construction of their own bodies. Ultimately, all organic materials are oxidized and their stored energy released. With this step, all the elements they contain are freed and again become available to green plants.

Life in the Water. The cycle of nutrition in an aquatic environment follows the same general pattern as on land. In the water the most important plants are the minute algae that cloud the fertile waters with a green haze. Feeding on these plants are myriads of small animals like the abundant water flea. These in turn are consumed by small fish that soon become the food of larger ones. As on land, scavengers and bacteria finish the cycle and restore to the water the nutrients that were originally used by the algae.

Seasons in the Lake. Four lake cross-sections indicate the temperature variations that occur within a body of water throughout the year. Water reaches its maximum density at 39° Fahrenheit. The effect this has on the circulation and the oxygen content of water at various levels is indicated.

Seasons in the Woods. The progression of the seasons brings much more marked changes in a deciduous — leaf-shedding — forest than in an evergreen forest. In the spring the sunshine reaches the forest floor in almost its full strength. Many of the small plants of the forest bloom, produce a year's store of food, and ripen their seed in the short interval before the trees put on their leaves. Others, like the goldenrod and aster, grow slowly all summer in the dim light that filters through the canopy, and in the fall, as the leaves of the trees begin to drop, they burst into sudden activity, blooming and forming seed in a few weeks. The activities of woodland animals also change with the seasons and many of the birds are members of the community only during the summer.

The Changing Forests. In sites with uniform conditions of soil, drainage, exposure, and climate there is usually one type of community that is more enduring than any other. It is called a climax community. In an area with

Pond Predators. *A series of progressively larger predators forms an important part of the cycle of life in any environment.*

a wide variety of conditions, such as Pine Plains, there are a number of site climaxes — those of the lake, of the stream banks, of the muck soils, and so on. On the dry upland areas the climax community is a hardwood forest with hemlock mixed through it. Areas occupied at present by other communities tend to evolve toward this climax community if not disturbed. In this exhibit various early stages in the succession of vegetation that ultimately leads to the forest are shown.

Man and the Land. These five panels show important periods in the history of land-use in the Pine Plains area: (1) The extensive forest broken only here and there by small Algonkin Indian settlements. These Indians practiced a primitive agriculture in order to supplement the wildlife they harvested from the forest. (2) In the 1700's the white settlers began to move in and clear away the forest to make fields. (3) The soil, rich with the humus that had accumulated for centuries under the forest, grew bountiful crops for over a century. (4) By the 1800's the failure to replace the nutrients which had been shipped away in the crops led to exhaustion of fertility. The availability of new, more fertile land in the West lured many farm families away. (5) Today we see the area in a new cycle of agriculture based on the extensive use of soil-building, erosion-controlling grasses and other forage crops supplied with the nutrient elements they need by the proper use of commercial fertilizers. The common agricultural tools of each period are shown in miniature.

THE HALL OF NORTH AMERICAN FORESTS

The landscape of Pine Plains has been dissected and analyzed for you in Warburg Hall. This landscape is composed of a variety of natural and artificial biotic communities. In the Hall of North American Forests one major type of biotic community — the forest — is analyzed and dissected. In the Hall of Forests the variety of this type of community, from northern Mexico to central Canada, is seen in 11 habitat groups. Many aspects of the internal workings of the community and of external influences upon it, including man's use of the forest, are shown in a number of smaller exhibits.

The Forest Community. The forest is a biotic community, composed not just of trees, but of many other plants and a variety of animals. In the forest, as in every biotic community, the life of any one species hinges in some way upon the life of every other species. One of the most basic interrelationships in the forest is found in the circulation of food through the community, often termed the food web. All food in the forest ultimately originates from the tissues of green plants — the algae, mosses, ferns, herbs, shrubs, and trees. The green plant obtains from its inorganic environment the raw materials from which it manufactures food. The energy necessary for the synthesis of this food comes from the sun. Many animals — herbivores — feed upon the green plants. In turn, the herbivores are the food of other animals — the carnivores. The bulk of living material and energy contained

Boreal *Spruce—Fir Forest Group*

in each successive step of this feeding cycle are significantly reduced. A typical food chain — one of many chains which comprise the food web of the forest — is shown in this exhibit.

Stories a Stump Can Tell. Each year both hardwood and coniferous trees form a new sheath of wood, encasing all the wood previously formed. When a tree is cut, the wood formed during successive years appears in the cut surface as a series of ever larger rings, all with a common center point. Because the characteristics of these rings are influenced by external conditions, the rings form an easily interpreted autobiographical record of the tree and of the forest in which it grew. The tree cross sections in this exhibit show a few of the many interesting stories that a stump can tell.

Coast Redwood Forest Group. From southwestern Oregon to the Santa Lucia Mountains south of Monterey, California, the coast redwood forest stretches almost continuously for 450 miles. This forest occurs primarily at altitudes below 1,000 feet in the mountains which front upon the Pacific

Ocean. Here the climate is mild and rainfall is abundant through most of the year. Condensation of water from the dense coastal fogs that blanket the area through the dry summer months provides a supply of moisture during this critical period. The redwoods are perhaps best developed near streams. This group, presented in semi-miniature, shows a portion of the Bull Creek Flat Grove in the Humboldt Redwoods State Park, near Dyerville, California.

Unlike its close relative, the big tree or Sierra redwood, the coast redwood sprouts readily at the base of living trees and around stumps of fallen trees. It is not uncommon to see several large redwoods growing in a circle, marking the site of a tree that fell long before.

The Elm in Northeastern United States. The American elm, one of six native species, occurs throughout the eastern United States, primarily in moist riverbottom areas. In New England the tree attains its maximum development, with some individuals reaching a height of nearly 100 feet and a diameter of five feet. Outstanding trees were often left by woodsmen and farmers clearing their land. Those trees, together with many thousands planted along the roadsides and in yards, form an intimate part of New England scenery.

The Big Tree in the Sierras. More than 60 scattered groves of big trees occur through 250 miles along the west slope of the Sierra Nevada Mountains in California. The big tree or giant sequoia grows in association with sugar pine (tree in right background), ponderosa pine, white fir, and incense cedar between the altitudes of 2,900 and 8,800 feet. It is closely related to the coast redwood and to the Metasequoia of China. The three species are living representatives of a group of trees that flourished beside the dinosaurs millions of years ago.

No big tree has ever been known to succumb to old age, insects, or disease. Some have been killed by lightning or toppled by wind or erosion. Perhaps more have been killed by the fires, which, before the establishment of protection in the groves, burned through them about once every twenty five years. Even though subjected to frequent fires the mortality of the big tree was not high, because its bark — often two feet thick — is an extremely efficient protection against injury by fire.

Unlike its relative, the coast redwood, the big tree does not sprout from the stump, but reproduces only from seed. The big tree seedlings are unable to survive in the deep litter of the undisturbed forest. Fires, however, burn this material away, exposing the mineral soil — a seedbed necessary for the successful establishment of the seedlings. Each fire, although damaging a few large trees, prepares the way for a new generation of trees. It is possible that the complete elimination of fire from the big tree forest could result in the virtual extinction of the species. The young Sierra redwoods depicted in the background of this exhibit may have started life following the fire that scarred the large tree beside them.

Giant Sequoia Log. Cut in 1891 from the Mark Twain Tree in the Big Stump Basin at the southwest edge of Kings Canyon National Park, this log is 16½ feet in diameter. The section weighs nine tons and has 1342 annual rings. To fell the tree required two men working for 13 days. The section was moved to New York in 12 pieces.

The big tree, which starts its life as a seed weighing less than one three-thousandth of an ounce, may live for more than 3,000 years. A large specimen may have a diameter twice as great as the diameter of this section, a height of 350 feet, a root system spread over 3 acres, and a total weight of 12 million pounds. A big tree, the General Sherman, is the largest living thing in the world.

Making Maple Syrup in the Catskills, 1870. This sugar bush in the Black Dome Valley south of Maplecrest, New York, is an excellent example of human modification of the forest. From the natural stands of the northern hardwood forest a nearly pure stand of sugar maple has been developed. As the maple sap trickled into the pails hung from the trees it was collected and hauled to a lean-to. There the sap was boiled over an open fire fed with the wood of the unwanted trees cut from the sugar bush. In this manner beech, birch, hemlock and other species were eliminated from the forest.

Early October in Southern New Hampshire. The woodlands of Sunset Hill, on Sunapee Lake, are a part of the northern hardwood forest. Beech, sugar maple, and hemlock are the most characteristic species in this forest type. But several additional species are normally present and may be locally favored by soil conditions, lumbering, or some natural disturbance. At Sunapee Lake, for instance, the red pine and paper birch became abundant after a severe windstorm which uprooted many trees, thereby providing a bare mineral soil and sufficient light for their establishment.

The Vegetation of Middle North America. This large map shows the distribution of the major vegetation types of North America, from northern Mexico to central Canada.

The Forest: River-Bottom to Hilltop. Although the major forest regions occupy hundreds of square miles, they are by no means homogeneous throughout. Among many factors which cause local variations in vegetation are the changes in moisture and soil associated with the ascent of a slope from a stream to a hilltop. This mural illustrates an idealized slope in the eastern portion of the oak-hickory forest region.

Mixed Hardwood Forest Group. Mixed hardwood forests occupy a large portion of the eastern United States. In the moist coves or small valleys of the Great Smoky Mountains the community perhaps reaches its maximum development. Here as many as 30 species of trees may contribute to the leafy canopy of the forest. A number of species of trees attain their maximum size in the area. This group, collected in Great Smoky National Park near Gatlinburg, Tennessee, contains 12 species of trees. Outstanding among these

are the giant tuliptree, the scaly-barked sweet buckeye, and the silver bell, shown in bloom near the center of the group.

Southeastern Coastal Plain Forest Group. Swamp forests of bald cypress occupy the quiet, shallow waters along the Coosawhatchie River near Coosawhatchie, South Carolina. In the less frequently flooded areas, nearer the river banks, the swamp forest is composed of blackgum, redbay, and southern magnolia. With a small rise in the ground level, elevating the surface a foot or so above the water table, the transition to pine flatwoods is very sharp. The flatwoods are made up of longleaf pine, loblolly pine, and an occasional spruce pine..

Giant Cactus Forest Group. In the arid regions of the southwestern United States, as in arid regions over the world, many plants have become adapted to the meager rainfall. Annual plants complete their life cycle in a few weeks during the rains, producing flowers and seeds, and die when conditions become unfavorable. Other plants, which live for several seasons, grow during the wet periods then shed their leaves and remain dormant through the dry period. Still another method by which plants endure desert conditions is by storing a supply of water during the wet season for use when soil water is not available. The giant cactus, or saguaro, employs this method and can be seen to swell during wet periods and shrink during dry periods. The accordion-like structure of the cactus allows these variations without injury to the plant.

The widely spaced saguaros, which have well-developed woody frames, form a sparse forest — a community peculiar to the Sonoran Desert. This group was collected in Saguaro National Monument near Tucson, Arizona. It shows the appearance of the desert at the time of the spring rains.

Piñon-Juniper Forest Group. In this group, collected from Colorado National Monument near Grand Junction, Colorado, two forms of the piñon-juniper forest are shown. The large, relatively luxuriant forest in the foreground is growing on fine-textured soils derived from shale. The moisture and nutrient relations in these soils are very favorable to tree growth. The red soils in the canyon below are derived from a coarse sandstone formation. These soils are droughty and low in nutrients. A sparse and stunted piñon-juniper woodland, frequently called a pigmy forest, has developed on them. Several of the piñon pines have been damaged or killed by porcupines.

Timberline in the Northern Rockies. In high mountains and in polar regions conditions are not favorable to tree growth. Short growing seasons, low temperatures, and strong winds, among many factors, act to limit forest growth. This group, depicting an area near Logan Pass in Glacier National Park, Montana, situated at an elevation of 6,664 feet, shows a typical view at timberline in mid-July. The stunted and gnarled white bark pines, engelmann spruce, and alpine fir are the last vestige of the extensive coniferous forests found at slightly lower elevations. Small groups of trees occur far above where we are standing, enabled to survive by the protection afforded by a boulder or a rock ledge.

Giant Cactus Forest Group, Saguaro National Monument

Fire in the Forest. This mirrorscope is a demonstration of the detrimental effect of a severe forest fire. Before your eyes, within a few seconds, it seems that trees are killed; the litter is burned away, baring the soil to erosion; and forest animals are killed or deprived of food and cover. The blackened area is a blemish on the landscape and may remain so for many decades.

How Nature Harvests the Forest. In the forest, just as in every biotic community, there is a continuous, virtually unnoticed harvest of plant materials by herbivorous animals, parasites, and through physiological and climatic influences. This harvest, which is constantly balanced by new growth, forms a basic step in the circulation of food through the community. Periodically, however, whole forests are harvested by nature.

Periodical natural harvests may be relatively slow, as in the case of harvest by the engelmann spruce bark beetle. This insect may require several years to harvest a forest. Other natural harvest may occur rapidly over a large area. Fire and wind are examples of rapid agents of harvest.

Following the harvest, if severe erosion or extreme climatic conditions do not interfere, the forest begins to reproduce itself. Barring a premature new harvest, the forest is eventually re-established.

Natural harvest is, by human values, extremely wasteful. A tremendous volume of timber is annually destroyed by fire. Great numbers of trees are broken and subsequently rot after each severe windstorm. Wildlife is killed or forced to move away. The protection afforded to the soil is removed, allowing water to run off rapidly, carrying with it valuable topsoil.

Southeastern Coastal Plains Forest Group. *Near Coosawhatchie, South Carolina, along the Coosawhatchie River, are swamp forests of bald cypress, black gum, redbay and southern magnolia. With a small rise in the ground level, other trees predominate.*

Forest Tree Diseases. A great number of living organisms and many non-living factors are responsible for diseases that may retard the growth rate of a tree, seriously injure the tree, or kill it. Through the damage they cause. diseases diminish the value of the forest for watershed protection, for wildlife production, and for recreation, and reduce the commercial value of the timber.

Forest diseases may be classified according to the agent which causes them. The exhibit includes examples of non-infectious diseases (drought damage) and infectious diseases. The agents of infectious diseases include viruses (elm phloem necrosis), alga-like fungi (little leaf disease), sac fungi (chestnut blight), club fungi (red rot), and parasitic flowering plants (dwarf mistletoe).

Forest Insects. The insect fauna of the forest is extremely diverse. From seed to maturity a tree, the typical forest plant. serves as the source of food and shelter for innumerable species of insects. Most of these insects inflict but minor damage. There are a number, however, which may severely injure or kill the tree. Many of these injurious insects are destructive only during one part of their life-cycle.

Forest insects may be classified according to their relation to the tree. Eight insects are shown in the exhibit: *Bud and leaf feeder:* spruce budworm: *Leaf miner:* birch leaf miner; *Leaf gall maker:* spongy oak-apple gall wasp: *Twig borer:* white pine weevil; *Cambium borer:* southern pine beetle; *Wood borer:* locust borer; *Sap sucker:* cicada; *Nut borer:* common acorn weevil.

Olympic Rain Forest Group. The dense forests of the Olympic Peninsula, composed of douglas fir, Pacific silver fir, western hemlock, big leaf maple and other species, have developed in the rainiest area in the United States. At Lake Quinault in the Olympic National Forest, Washington, the site of this group, the average annual precipitation is 129 inches. Mount Olympus (7915 feet), visible in the background, is estimated to have 250 feet of snow each year.

How Man Harvests the Forest. Foresters have developed several basic methods by which they harvest the forest. These methods are designed to assure continuous production of tree crops from the harvested area. The choice of method is determined primarily by the requirements of the trees that are to be grown.

The three methods of harvests illustrated in this exhibit are the clear-cutting method, the seed tree method, and the selection method. Clear-cutting involves the removal of all the timber in the harvest area. This area is usually small in comparison with the uncut area surrounding it. Subsequent tree crops are derived from the seed of the harvested trees or from adjacent forest trees. In some cases young trees may be planted. The douglas fir of the northwestern United States is often harvested by this method.

In the seed tree method the timber is harvested primarily by a single cutting. However, selected trees or small groups of trees are left as a source of seed to establish reproduction on the harvested area. After the seedlings have become established the seed trees are cut. Loblolly pine in the southern United States is harvested by the seed tree method.

Through the selection method trees are harvested individually or in small groups. Young trees begin growth in the openings created by the harvest. The unharvested portion of the forest provides a source of seed and protection. At relatively short intervals, depending on the rate of growth of the forest, other trees are removed. In the northeastern United States the red spruce is harvested by the selection method.

Forest Protection. Forest protection is vital to the production of tree crops. Many of the innumerable injurious animals, plants, and non-living agents are so destructive as to virtually prevent the forest growth unless protection is afforded. Accelerated natural harvest or human carelessness which results in the destruction of mature trees reduces the value of the forest for watershed protection, timber production, wildlife production, recreation, and other activities. The most effective protection is prevention before damage begins to develop rather than control after damage is widespread.

Methods used in protection against forest fires, against insects and diseases, and against larger animals are illustrated in this exhibit.

Multiple Use of Forest Lands. Humans derive many benefits from forest lands. Forests, of course, are our only source of timber. In addition, however, forested watersheds are our greatest and most reliable sources of water. Soil

Left: Coast Redwood Forest. *This group, presented in semi-miniature, shows a portion of the Bull Creek Flat Grove in the Humboldt Redwoods State Park, near Dyerville, California. The coast redwood forest stretches almost continuously for 450 miles, from southwestern Oregon to the Santa Lucia Mountains south of Monterey. This forest occurs primarily at altitudes below 1,000 feet in the mountains which front upon the Pacific Ocean.*

Above: Forest Protection. *Forest protection is vital to the production of tree crops. The models in this group show some of the methods used in protection against forest fires, insects, diseases, and larger animals. Too many browsing animals in many forested areas lead to a condition of intense competition for food, causing the animals to crop leaves and twigs more closely and to eat species ordinarily left untouched. In the absence of natural predators, regulated hunting is actually beneficial to the forest.*

Timberline in the Northern Rockies. *This group shows an area near Logan Pass in Glacier National Park, Montana, with typical view at timberline in mid-July.*

erosion is greatly diminished due to the protection which the forest provides. Many forms of wildlife live only in the forest and many others depend on the forest for a portion of their needs. The clear, shaded streams in forested areas are the homes of many species of fish. Man also derives aesthetic benefits through his association with the forest, making it a valuable resource for recreation.

How We Use Our Timber. Virtually all the wood used by man comes from the forest. A portion of this wood is used just as it is obtained from the forest. The remainder is processed in many ways to produce the thousands of wood products used in everyday life. This exhibit shows the relative proportions of wood that leave the forest in the form of pulpwood, sawlogs, fuelwood, and other forms, and the value of the products produced from this wood.

Oak-Hickory Forest Group. The development of strata or layers of vegetation is one of the most striking phenomena of forest structure. The massing of vegetation at several levels is an extremely economical use of the available space, allowing as much as ten acres of leaf surface to be exposed over a single acre of land. Layering is extremely well developed in the oak-hickory forest represented in this group, which was collected along the Current River in the Ozark Mountains near Eminence, Missouri. The overstory, or taller tree layer, is made up of white oak, red oak, and mockernut hickory, while the understory is composed chiefly of dogwood trees.

Jeffrey Pine Forest Group. The jeffrey pine forms a pure forest in the Indiana Summit area, a few miles east of the Sierra Nevada Mountains, near Crestview, Mono County, California. In the past many fires have swept through this area, leaving many trees scarred and blackened. At least a few of these fires may have been started by the Indians who dug the trenches still visible around the bases of the larger pines. These trenches were designed to trap

Big Tree or Giant Sequoia *(Sequoia gigantea) This section of the Mark Twain Tree began growing in 550 A.D., and was cut in 1891 in the Big Stump Basin at the southwest edge of Kings Canyon National Park. It weighs nine tons and has 1,342 annual rings.*

the fat larvae of the Pandora moth which until recent years descended the trees in great numbers each spring. Fires were occasionally built near the base of the tree to smoke the caterpillars out. The roasted caterpillars were a great delicacy for the Indian.

Boreal Spruce-Fir Forest Group. The great boreal coniferous forest is virtually continuous from the Atlantic to the Pacific, across the northern portion of the continent. On the cliffs above Lake Nipigon, near Macdiarmid, Canada, forests of white spruce and balsam fir cover many acres. On burned-over land, illustrated at the right side of this group, the quaking aspen and paper birch are quick to establish themselves. These trees, which are easily killed by shading, are eventually replaced by the shade-enduring spruce and fir. A swamp forest of black spruce has developed on the sheltered lake shore below the cliff. The islands far out in the lake, well protected from fire, support mature stands of spruce and fir.

Forest Soils. The forests of North America occur primarily on three major soil types: the podzol soils, the gray-brown podzolic soils, and the red-yellow podzolic soils. The podzols are found in the northeastern United States, across Canada, and in Alaska. The extensive boreal forests occur almost exclusively on podzols. The gray-brown podzolic soils are found throughout

the central eastern United States, and support the extensive hardwood forests of this region. In the southern United States, the red-yellow podzolic soils are covered primarily by forests of pine or mixed oaks and pine.

Each section of the exhibit shows a vertical cut or soil profile. The backgrounds suggest the appearance of a forest typically found on each soil type and the wildflowers growing from the soil are species characteristic of each soil type. The central part of the root system of a typical tree is shown just as it was found in each soil. These trees illustrate the two main types of root systems. The long leaf pine in the red-yellow and the shellbark hickory in the gray-brown soil are examples of tap-rooted trees. The red spruce in the podzol soil has a fibrous root system.

Weather in the Forest. The structure of the forest community is responsible for a distinct climate within the forest. Through shading, wind protection, water loss, and snow and rainfall interception, the forest effectively modifies the local weather conditions. This diagrammatic mural illustrates the weather in an oak-hickory forest near New York City at 2 p.m. on a sunny July day, a few minutes before daybreak the next morning, and at 2 p.m. the next afternoon during a rain storm.

Life of the Forest Floor. Except at its surface, the world of the forest floor is always dark. The tiny plants and animals here are vital to the forest's economy. Through their activities, the plant and animal remains which rain down from the forest's upper levels are broken up and decomposed and the nutrients they contain are again available. This exhibit gives a worm's eye view of a small section of the forest floor.

popular versus scientific words

Every task of man has its own special words. Doctors, sailors, lawyers, shoemakers, scientists, cooks and cattlemen — all have their own word lists that they use in their work. Our trouble is that we cannot be familiar with all of these occupations and their special words.

Living languages grow and change in meaning with daily use. For example, take two English words, ***Prevent*** and ***Let.*** ***Prevent*** used to mean ***Anticipate.*** "He prevented her every wish" did not mean that she didn't get what she wanted. It meant that he could tell beforehand what she wanted. Today, ***Prevent*** means ***Stop Something Before it Happens.***

Let used to mean ***Stop.*** In Shakespeare's time a man might say, "Let me not!" meaning "Stop me not!" But today, ***Let*** means ***Permit*** or ***Allow.***

Common names also change with locality. Every species of animal may have scores, if not hundreds, of local names. Even the same name may not mean the same thing in different regions that speak the same language. The ***Whiting*** of England is not found in America, but the ***Hake*** of England is the ***Whiting*** of New England, while the ***Hake*** of Delaware Bay is a totally different fish that has nothing to do with the other two. Again, the English ***Ling*** and the ***Ling*** of New Jersey are different fishes.

It is plain, then, that scientists must have an international language. The solution has been to make up a word list from one or two "dead" languages that will not grow and change as time goes by. Sometimes words from other languages may be employed. Sanskrit and Hebrew would have served, but early scientists knew Greek and Latin better.

To avoid confusion, scientific names are given to animals and plants. All scientists will know these names. Our domestic dog is "dog" in English, "hund" in German, "hond" in Dutch, "chien" in French, "perro" in Spanish and "cão" in Portuguese. But all scientists — American, English, German, Dutch, French, Spanish or Portuguese — will know that ***Canis familiaris*** is a dog in any dialect.

The Museum visitor may be surprised to find, after reading a label, that after each common name of an animal there are two words in a foreign language — usually Latin and Greek in combination. For instance, after Robin, you will find ***Turdus migratorius;*** after Herring, ***Clupea harengus.*** Every known animal has been given scientific names whether it has a common name or not.

But why ***Two*** scientific names? The two names have two functions. The Black Duck is ***Anas rubripes. Anas*** is the generic name — it indicates relationship. Every surface-feeding duck is ***Anas,*** as the Mallard, ***Anas platyrhyncos;*** the Pintail, ***Anas acuta;*** the Teal, ***Anas crecca.*** The second name, beginning always with a small letter to set it off, is unique. It specifies the particular species. It is the specific name.

To apply the same system to human names, let's take John Smith. The scientist reverses his name thus — ***Smith john. Smith*** is his generic or relationship name. All members of his family will be named ***Smith.*** But when we add ***john*** to his relationship name we now has a specific name. a unique name. ***Smith john*** cannot be confused with ***Smith peter, Smith bill*** or ***Smith charles.***

In addition to using Latin and Greek names, scientists also use short-cut descriptive words. It is harder to write simple language than it is to write scientific language. It also takes more words and more space. Scientists compress their words to save time and space.

Let us take ***Prognathous*** as an example. We may say that one type of primitive man was prognathous. ***Prognathous*** is a descriptive word made up of Latin and Greek words. ***Pro-*** is a prefix meaning ***Before*** or ***Forward. Gnathos*** is a Greek word meaning ***Jaw.*** The suffix ***-Ous*** means ***Having the Quality or Presence of Something.*** Therefore, ***Prognathous,*** part by part, means ***Forward-Jaw-Presence*** or, more simply. ***Having a Jaw That Sticks Out. Prognathous*** is a time-saving, short-cut word. But it takes many words to explain what it means.

We have gone around the fifty-eight halls of the Museum, reading labels. We have picked out words that we thought were least familiar to everyone. If you are reading a label and come across a word like ***Prognathous*** or

Pectoral, you can find what it means in the word list below. If you find words not on our list that you think ought to be there, please note them and pass them on to any Information Desk. Your suggestion will be given to the right people.

THE WORD LIST

Aberrant, straying from the usual course; differing from the type of its group.

Albino, a person, animal, or plant lacking normal coloring matter.

Alluvial, pertaining to formations deposited by rivers or floods. Alluvial plains are the flood-plains of rivers.

Aquatic, living in a water environment.

Arboreal, living or situated among trees.

Archaeology, the systematic study of man, his relics, remains and records.

Artifact, a product of human workmanship.

Avifauna, the birds of a given region.

Bench, a narrow, raised level surface of ground or rock.

Biotic Community, a community composed of both plants and animals.

Boreal, northern.

Calcareous, composed, of, or containing, limestone or calcium carbonate. A clam shell is calcareous.

Canopy, the leafy cover formed by the tallest trees in the forest. Also called the overstory.

Carnivore, a meat-eater. A lion is a carnivore.

Celt, an ancient tool or weapon of stone, shaped like an axe.

Ceramic, Pertaining to pottery.

Coniferous, plants which bear seeds in cones and usually have needle-like leaves.

Crustacean, a lobster, crab, crawfish or shrimp is a crustacean.

Culm, stem or stalk, as of grasses.

Culture, the sum total of everything a group is, does, has, and believes in.

Deciduous, falling off at maturity, as of leaves of maple.

Decoction, the liquid produced by boiling a substance.

Detritus, loose fragments or particles of rock.

Diurnal, active during the day. The eagle and the sparrow are diurnal birds.

Dorsal, pertaining to, or placed on or near, the back.

Effigy, a figure or image representing the whole or part of a person.

Environment, one's surroundings.

Epiphytic, growing upon another plant, usually on trees, but not parasitic.

Everted, turned backward or outward.

Evolution, a succession of changes by which the forms of organisms are modified, usually from the simple to the complex.

Fauna, all the animals living in a given area.

Flora, all species of plants growing in an area.

Generic, pertaining to race or kind.

Glyptic, pertaining to carving or engraving.

Graminivore, a grass-eater. A horse is a graminivore.

Gregarious, living in flocks, herds or communities. Pigeons, cows and men are gregarious.

Growing Season, the period between the last freeze in spring and the first freeze in fall.

Hardwood, a tree that bears broad leaves with netted veins, rather than needles or leaves with parallel veins. The oaks and maples are hardwood trees.

Herb, a plant with no woody parts above the ground.

Herbivore, an animal that feeds upon plant materials. A deer is an herbivore.

Hibernation, passing the winter in a secluded place, in sleep or near-sleep.

Hieroglyphic, picture-writing in which the figures of objects take the place of signs or letters.

Inorganic, not a product of a living organism.

Insectivore, insect-eater.

Intrusion, the forcing of masses of molten rock into or between other rocks; a mass of such rock.

Invertebrate, an animal without a backbone.

Lateral, pertaining to, or placed near, the side.

Leached, dissolved out by a percolating liquid.

Legume, a member of the pea family.

Melanistic, excessive darkness of the eyes, hair, fur, or skin, due to deposits of pigment; the opposite of albinistic.

Metallurgy, the art or science of extracting metal from its ore.

Metamorphosis, a change in form, structure and function resulting in development; the changes that occur from the larva and pupa to the fully developed insect.

Nocturnal, active after dark. The owl is a nocturnal bird.

Nymph, immature insect form.

Occipital, pertaining to the lower back part of the head.

Organic, derived from a living organism.

Parasitic, living on or in another organism and getting nourishment from it.

Pathogenic, causing disease.

Pectoral, pertaining to the breast.

Pedicels, stalks or supporting parts.

Pelagic, pertaining to the ocean.

Photosynthesis, the process by which green plants manufacture simple foods from carbon dioxide and water under the influence of sunlight.

Physiography, physical geography, dealing in description rather than in theory or explanation.

Predatory, preying on other animals.

Prehensile, formed to grasp or coil around, as the tail of a monkey.

Primeval, belonging to the first ages; ancient.

Proboscis, a long, flexible snout, as the trunk of an elephant.

Prognathous, having a jaw that sticks out.

Ruminant, an animal that chews the cud, as deer or cows.

Saprophytic, living on dead organic matter.

Scandent, climbing or aiding to climb.

Sedimentary, formed originally by material deposited by water or air.

Sessile, fixed to or attached.

Sherds, fragments of pottery.

Stela, an upright slab or tablet of stone.

Stratigraphy, the order and relative position of the layers of the earth's crust.

Synopsis, condensed statement: general view.

Synoptic, giving a general view of a whole.

Terrestrial, pertaining to the earth.

Tundra, the treeless plains found in the arctic regions.

Understory, the leafy cover formed by the lower trees in certain forests.

Vegetation, the total plant cover in an area.

Ventral, pertaining to, or placed on or near, the abdomen.

Vertebrate, an animal with a backbone.

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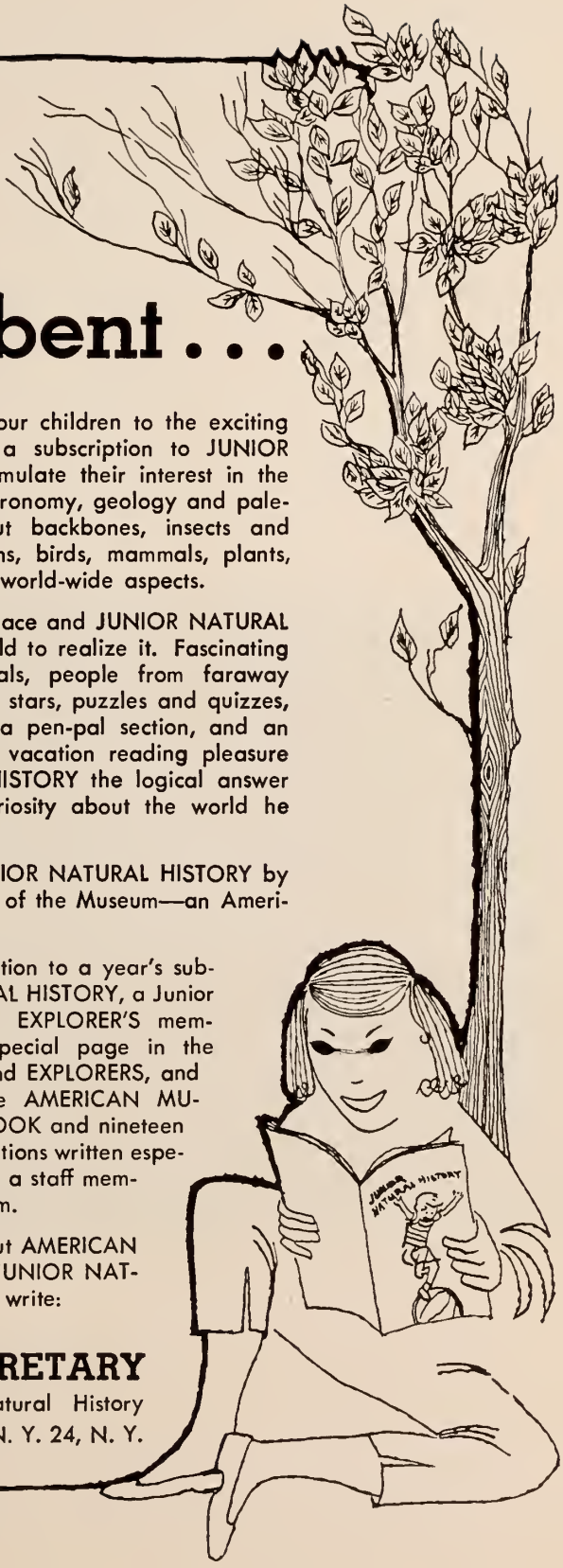

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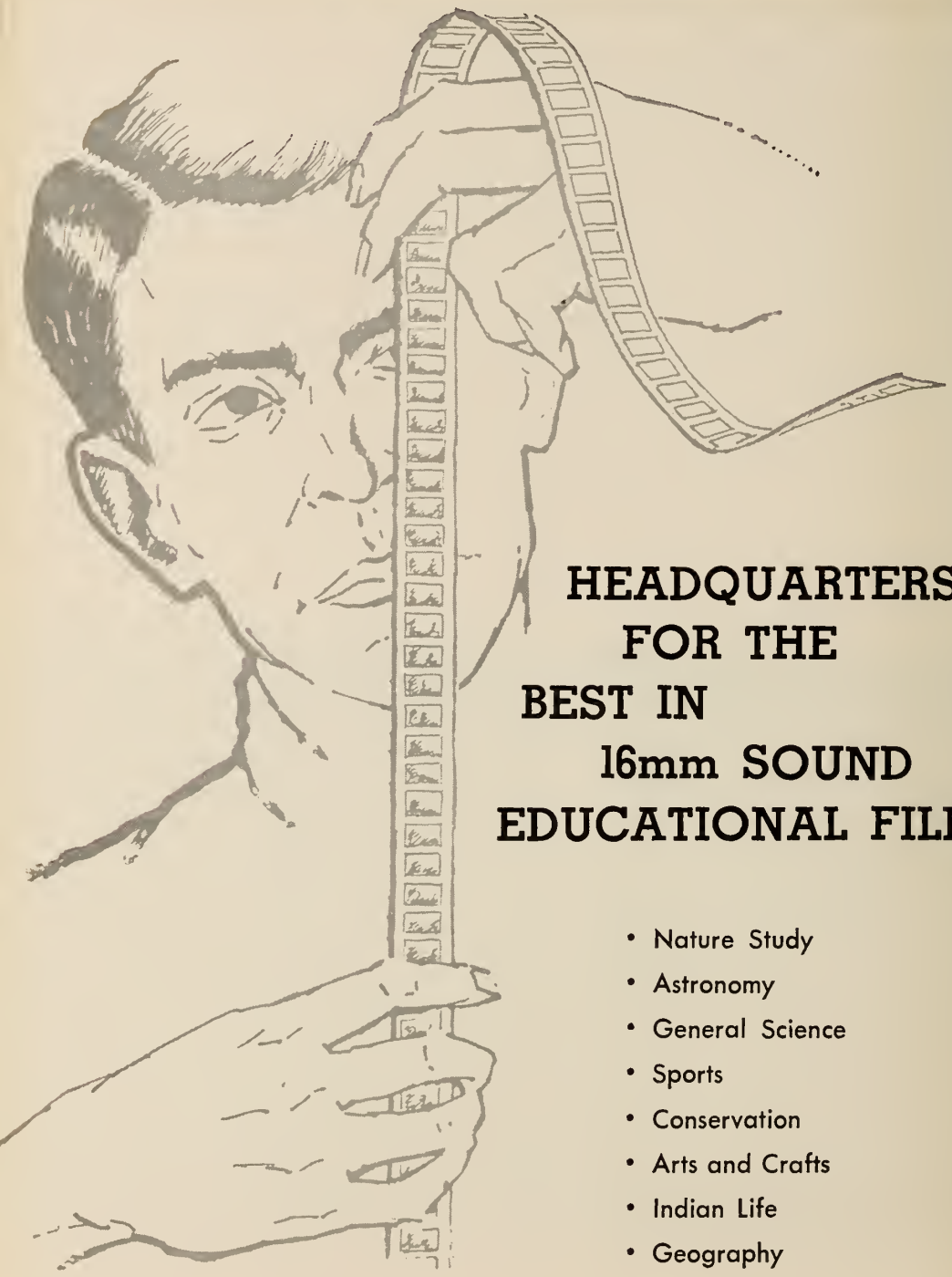

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