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AHNIGHITO, OR THE TENT

The largest of the Cape York meteorites. Removal from the Cob Dock, Brooklyn Navy Yard

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No. 1

THE CAPE YORK METEORITES.



SINCE the time of Captain Ross's voyage to northern Greenland in 1818, the world has known that the Eskimo whom he found there were provided with knives and other utensils which were armed with iron. The source of this iron was a puzzle, since the Eskimo did not then possess, nor do they now have, the means for reducing any of the metals from their ores. The natives merely said that the metal came from the "Iron Mountain," and they would give neither Ross, nor any of the succeeding explorers who have visited the region, exact information regarding its location, until Commander Robert E. Peary gained the esteem and confidence of the tribe to such an extent that the secret was revealed to him. On May 27, 1894, he and Hugh J. Lee, a member of his expedition, under the guidance of Tallakoteah, an Eskimo, were the first white men to behold any of the "Saviksue" or Great Irons. Two hundred miles of terrible sledge travel, amid many and great dangers, had been necessary to attain this object.¹ On this trip was found the medium-sized mass known as the Woman, now on the fourth floor of the Museum, but the advent of stormy weather and the rapid approach of the breaking-up of the ice in the spring prevented visiting the largest mass, which was only six miles away on another small island. Tallakoteah picked up a boulder lying beside the Woman and illustrated the method used by his ancestors for getting material for their knives by pounding at an edge of the mass until a bit of the iron was loosened enough to be removed. Not since about the time of Ross's visit have the Eskimo resorted to

¹ A thrilling account of this journey and a full description of the removal of the Saviksue to New York may be found in Commander Peary's book, "Northward over the Great Ice."

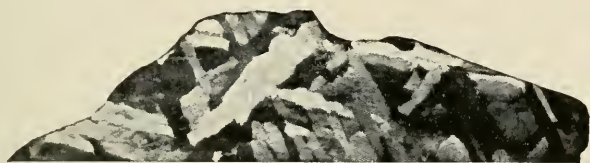
the Saviksue for iron, their wants being met by whalers and by trading with the natives farther south.

In 1895, Peary returned to Melville Bay and took his ship to Saviksoah Island to obtain the masses of iron. The Woman and a smaller meteorite, known as the Dog, from its size and shape, were successfully loaded on board the ship "Kite" after much difficult and exciting work, an incident of which was the breaking-up of the cake of ice on which the Woman had been ferried from shore to ship, just as the mass was about to be hoisted aboard. Fortunately, there was enough tackle around the iron to prevent the loss of the object which had been so long and eagerly sought. Without further incident, the two masses of iron were transported to New York and deposited at the Museum. The great mass, called by the Eskimo "Ahnighito" or the Tent, was visited by Commander Peary on this trip, but with the means at hand nothing could be accomplished toward moving the iron from the ledge on which it had rested for ages.

The following year, the indefatigable explorer made another voyage to the inhospitable shores of Melville Bay to bring Ahnighito away. Again was the project unsuccessful, by reason of inadequate apparatus and inclement weather. Once more, in 1897, Peary returned to the attack, this time with a one-hundred-ton and two thirty-ton jacks and ample supplies of railroad iron and great timbers, determined to win at all hazards. To transport a compact, rounded mass of iron of great weight down a rocky slope several hundred yards to the sea and to store it safely, with no dock or dock machinery, in the hold of a ship for a journey of three thousand miles would be difficult under any circumstances, but the problem of moving Ahnighito was vastly complicated by the ice, the fog, the winds and the other adverse conditions of the west coast of Greenland at latitude 76° N., and the task may well be compared with that which faced Lieutenant Gorringer in removing the obelisk from Egypt to Central Park. The ship "Hope," built expressly for Arctic exploration, was moored directly to a rocky promontory, where she lay at the mercy of any storm that might come up, while the last days of the anxious work were progressing. As the monster meteorite came aboard ship, the four-year-old daughter of Commander

Peary, herself born near Cape York, broke a bottle of wine over the mass and christened it "Ahnighito," her own musical name.

With the great mass secured within the hatchcombings, the prow of the "Hope" was turned away from Saviksoah Bay and full steam was crowded on to escape from the dangerous place, where the rapid forming of new ice, presaging winter, threatened the adventurous white men with long imprisonment. Great anxiety was felt by the intrepid Peary and his men while the ship was forcing her way out of Melville Bay, for it was several days before the great mass of iron could be lowered to the bed of stone ballast provided for it deep in the hold and be secured where it could not overturn the vessel or break through her sides during a storm.



ETCHED SURFACE OF AHNIGHITO, SHOWING WIDMANSTÄTTEN LINES

From the autumn of 1897, when the "Hope" discharged her valuable load at the Cob Dock of the Brooklyn Navy Yard, Ahnighito lay there in comparative obscurity until last September when the great mass was once more set in motion. Lifted by a great crane which makes child's play of handling a mogul locomotive, the meteorite was transferred to a lighter and towed around to the foot of Fiftieth Street, North River, where a massive iron truck, capable of carrying a 100-ton load, was in waiting for the last stage of the journey. Twenty-eight powerful horses, forming a line the length of an avenue block, were required to pull the truck and its load through the streets. On October 1, the great meteorite arrived at the Museum and ended its travels. Here it rests on a six-foot cube of solid concrete and rubble. The dimensions of the iron are, length 10 feet 10 inches, height 7 feet 2 inches, thickness 5 feet 6 inches.

In order to determine the exact nature of these great masses of iron, chemical analyses of all three have been made and slices

have been cut from the Woman and Ahnighito, which have been carefully polished and etched in order to determine the presence and character of the Widmanstätten lines. The analyses¹ show that the material is an alloy of iron and nickel, with a small amount of cobalt and minute percentages of other elements present. The etched surface shows that the iron is to be described as belonging in the octahedral division. The lamellæ are rather broad (1. to 1.5 mm) and under Brezina's classification the iron would be called a "Broad Octahedrite (Og)." The character of the figures may be seen from the accompanying illustration. (See p. 5.) The lamellæ are rather long and straight and sometimes gather together in groups.

The nature of the surroundings amid which the masses were found precludes the idea of their being anything but meteorites. The country rock is gneissoid in character, according to Professor R. D. Salisbury, who visited the island in 1895 with Commander Peary, and neither in the bedrock nor in the glacial drift covering the region, so far as seen, is there any of the igneous rock which is the only telluric rock known to contain metallic iron. The position of the meteorites when found, half-buried in drift, seems to indicate that they fell on the ice at a time when a glacier covered the islands. The close similarity of the three in position, chemical composition and texture renders it most highly probable that they fell at the same time. The Eskimo preserve a tradition, the origin of which is lost in antiquity, that the

¹ Results of chemical analyses of the Cape York meteorites made by J. Edward Whitfield of Philadelphia:

	No. 1. The Dog.	No. 2. The Woman.	No. 3. Ahnighito, or the Tent.
Iron.....	90.993 %	91.468 %	91.476 %
Nickel.....	8.265 "	7.775 "	7.785 "
Cobalt.....	0.533 "	0.533 "	0.533 "
Copper.....	0.016 "	0.018 "	0.014 "
Sulphur.....	0.019 "	none	none.
Phosphorus.....	0.172 "	0.188 "	0.202 "
Carbon.....	0.014 "	0.020 "	0.028 "
	100.012 %	100.002 %	100.038 %

None of the samples contained silicon or manganese. A trace of chromium was found in the fine oxidized particles from the surface of No. 3, Ahnighito, indicating the former presence of a nodule of variable composition.

Saviksue fell to the ground from the sky. Taken together they form the most interesting group of meteorites in any museum, not only on account of the unusual size of the largest mass, which is probably the heaviest meteorite known, but also on account of the struggle for existence maintained with their aid for untold generations by the most northern group of human beings on the globe.

EDMUND OTIS HOVEY.

THE CHINESE HALL.



ON Saturday, December 3, Hall No. 301, in the West Gallery, containing extensive collections from China, was opened to the public. These collections are the results of an expedition to China the funds for which were generously furnished by Mr. Jacob H. Schiff of this city, Dr. Berthold Laufer being intrusted with the work. The collections are intended to show the entire culture of China of the present day and to illustrate the products of the country and the general every-day life of the people,—their customs and industries, their amusements and pastimes and their religion and art.

Opposite the entrance, just in front of the railing, are exhibited four ancient bronze drums and an altar set of stone carvings, the central piece of which represents an incense-burner. On either side of the incense burner is a large flower-vase in open-work carving and a candle-stick. In front of this set are five dishes containing various kinds of fruit all in stone.

In the wall-case to the right of the entrance is shown modern crockery made in Peking, in its simple burnt state and in glazes of green and brown and various other colors. In the wall-case on the other side of the entrance is to be found glazed pottery from Poshan in the Province of Shantung, and a large variety of gray flower-pots made in Peking. These are of various forms, and are tastfully decorated. Other cases just in front of these wall-cases contain specimens showing the process of manufacture of pottery in its various stages, and there is a fine display of

porcelain illustrating the different types and colors employed in that branch of art. There are teapots in terra-cotta, polychromatic flower-vases from Canton and a group of clay lamps. The various metal industries of China are represented by objects of bronze, tin, pewter, copper, silver and iron.

Along the north wall are represented implements of copper and iron, glassware, agriculture, basketry and matting. Household articles, kitchen utensils, clothing, foot and head gear, fans, weapons and armor are fully represented. In one section the blacksmith's trade is illustrated, and in an adjoining section the carpenter's.

An entire section is given up to an elaborate display of all kinds of tobacco-pipes, the dry pipes as well as water-pipes, and opium-pipes. The various brands of tobaccos, snuffs and other smoking-materials also find place here. In one case are drugs and the apothecary's outfit, surgical instruments and needles used in acupuncture, the horse doctor's outfit and implements used in massage treatment. Other cases display carpets, bamboo, coir palm, chemical products, medicines, hygiene and cosmetics.

On the west side in one case are exhibited articles of food, and the implements of various industries,—butcher's, baker's, fruit-seller's, cake-seller's, stone-cutter's etc. In a wall-case are lanterns of paper, pongee and horn and an altar set of papier-maché. An exhibit of dolls showing various styles of dress is also to be seen on this side of the hall. In the same case is exhibited quite a collection of pigeon whistles. These whistles are attached to the tails of pigeons by means of fine wires, and when the birds fly through the air a plaintive sound is produced by the wind striking the holes in the whistles. Besides these, money, weights and measures; harness; shows, games and toys, and actors' paraphernalia and masks are all represented.

A special flat case in the southwest corner contains objects fully illustrating the printer's art; and along the south side of the hall are exhibited religion; wood, ivory, and stone carving; cloisonné and carved lacquer work; ancient pottery; musical instruments; embroidery, decorative art, drawing and painting, and ancient bronzes.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.



THE field work carried on by the Department of Vertebrate Plæontology in the Bridger Badlands in 1903 was continued during the season of 1904 by another expedition under the charge of Mr. Walter Granger. Parts of the region not visited or but slightly worked the previous year were carefully explored and much valuable and important material was obtained.

The Bridger beds are a Middle Eocene deposit in the southwestern part of Wyoming and lie for the most part between the Union Pacific railroad and the Utah State line. They cover an area of about two thousand square miles and represent a total thickness of nearly two thousand feet. In many places throughout this area, especially along the streams, these beds are cut and weathered into rough, rugged and very picturesque badland bluffs and slopes which have yielded to collections a large variety of very interesting fossil mammals as well as remains of turtles, crocodiles, lizards, fishes and birds. The first mammals to be reported from these beds were described about 1870 by Dr. Leidy from specimens secured by the Hayden Survey and by people residing at Fort Bridger. Since that time the country has been searched over by various parties, notably those sent out by Yale and Princeton Universities, the American Museum and by Professors Cope and Leidy.

The expedition from this Museum in 1893 which visited this locality and also the Washakie Beds, a nearly contemporaneous deposit lying some seventy-five miles to the westward, was fortunate in securing numerous skulls and some skeletal parts of *Uintatherium*, a large rhinoceros-like animal with three pairs of horns and a very large, flat, curved tusk or canine. This was by far the largest and most striking of the animals of this period. There was not sufficient material with which to compose a skeleton, however, and one of the chief objects of the expeditions of 1903 and 1904 was to secure the material necessary for a complete restoration of this beast, or better still a complete skeleton of one individual. The first season the party was working most of the time outside of the rather restricted area of the basin in which the uintatheres are found, but this year two important

specimens, fortunately of nearly equal size, were found, and a restoration of *Uintatherium* now seems assured. One of these skeletons was found in a very interesting and unusual position. The animal had evidently been mired in the clay in which the bones were found imbedded, and had died while the body was in an upright position. When excavated, the limbs were found extending straight down in a nearly natural pose, the hip was in place, but the skull, neck and most of the back had been weathered away.

Among the other specimens obtained during the past season were remains of rodents, carnivores, insectivores, monkeys and the primitive Horse *Orohippus*. The collections of the past two seasons are especially rich in specimens of these smaller forms and supplement admirably the material obtained from the same beds by the earlier expeditions.

Mr. Albert Thomson spent about four months collecting in the Big Badlands of South Dakota. This is the fourth expedition sent by the Museum to the famous Oligocene deposit. The locality has probably been more productive of fossil mammal remains than any other equal area in the world, and notwithstanding the numerous collections made there, the area appears not to have been exhausted. The expedition of 1904 secured a collection comprising nearly one hundred specimens and included at least two new genera and several new species. The new genera are a small ruminant and a rodent, intermediate in skull structure between the beaver and the squirrels. The collection also included two fine skulls of the large *Perissodactyl*, *Titanotherium*, and several fine skulls and jaws of the smaller rhinoceroses, as well as two turtles new to science, one a *dermatemyd*, the other a species of *Testudo*.

Mr. Barnum Brown conducted four expeditions during the summer of 1904. The first explored the Fort Pierre beds of South Dakota near Edgemont, where a unique collection of plesiosaur remains were obtained which will enable the Museum to place on exhibition the restored skeleton of this interesting sea serpent. There are two skulls with jaws in this collection and one specimen includes the skull, jaws and about 15 feet of neck, one paddle and part of body.

The second expedition, in Montana, obtained considerable material from the Judith River beds, including the greater part of a *Trachodon* skeleton. From the Fort Benton formation on the Crow Indian Reservation, several new forms of crocodiles were obtained.

The third expedition, in New Mexico, explored a hitherto unnoted deposit of Laramie Cretaceous, finding a large *Diclonius* skull and jaws. The most notable find, however, was made in the fourth expedition in the Pleistocene Crevasse of Northern Arkansas from which were secured several thousand skulls, jaws and limb bones representing about fifty species, many of which are living, while not a few are extinct forms. The collection is now being worked up and will prove of great interest in showing the range and distribution of many forms.

MUSEUM NOTES.



HERE is an increasing demand from teachers for the circulating collections which the Museum loans to public schools. More than a hundred of the schools of the city are using them at the present time. They have been studied by more than 30,000 children since the schools opened in September. The sets of birds and insects are most popular. This plan of supplying small nature study collections to the elementary schools has attracted considerable attention outside the city. Professor A. C. Haddon of the Horniman Museum, London, who, during a recent visit to the Museum, showed great interest in our work and made a careful study of our methods of supplying this material, has written for circulars, labels and other literature relating to this work, in order that he may present the project to the London County Council and persuade it to provide similar collections for the public schools of London.

THE International Congress of Arts and Sciences, at the Louisiana Purchase Exposition in September, 1904, brought to this country an unusual number of eminent scientific men, many of whom stopped at the Museum on their way to or from St. Louis.

Among the delegates to the Congress who have visited the Museum since September may be mentioned Sir William Ramsay, Sir John Murray, Dr. H. R. Mill, Major A. St. H. Gibbons and Professor Oldham of England and Scotland; Professors Cordier, Grandidier and Thoulet of France; the Graf von Pfeil and Professors Hugo Erdmann and Verworn of Germany; Professors Albrecht Penck and Eugen Oberhammer of Austria; Dr. Bela Erödi of Hungary; M. de Claparède of Switzerland; Professor Sraute Arrhenius of Sweden; Commissioner Maldanago of Chili; Dr. Garland of Peru; Colonel Peña of Mexico; Dr. Arpiazu of Spain, and Professor Kakichi Mitsukuri of Tokyo.

ON the evening of September 13, there was given a joint lecture by Dr. William Hunter Workman and Mrs. Fanny Bullock Workman on "Explorations among the Himalayas," under the auspices of the American Geographical Society and the Museum. The lecture was complimentary to the International Geographic Congress then in session.

OCTOBER 3 Professor Hugo de Vries, the eminent Dutch botanist, was the guest of the Museum.

THE most important accession to the Library during the year has been the gift of the private scientific library of Professor H. C. Bumpus, amounting to more than three hundred volumes and twenty-seven hundred pamphlets. This collection is especially rich in works in comparative anatomy and brings to the Library many valuable works and rare reprints not heretofore owned by the Museum.

THE Department of Geology has recently received a remarkable series of fossils from the beds of Hudson River age near Cincinnati, Ohio. All the specimens are in beautiful condition and many rare forms, especially of Echinoderms, are represented by several specimens.

ON December 2, the New York Academy of Sciences held a special meeting at the Museum for the purpose of hearing a lecture by Professor Albrecht Penck of the Imperial University of

Vienna. Professor Penck, who is an Honorary Member of the Academy, chose for his topic "The Glacial Surface Features of the Alps," a subject in which he is an eminent authority on account of the twenty years of almost continuous study that he has given to the valleys of these mountains.

DECEMBER 5, Prince Fushimi of Japan and his staff visited the Museum, spending most of their time in the recently opened Chinese Hall. A reception was tendered the prince by President Jesup and the Trustees of the Museum.

AFTER Mr. Chapman's lecture on "The Home Life of Flamingos," December 8, the Members of the Museum and their friends had a preliminary view of the Flamingo group and the San Joaquin Valley group which are in course of preparation at the north end of the Hall of North American Birds. These groups are the most elaborate bird groups thus far attempted at the Museum. Like the Cobb's Island group, a large part of the effectiveness of the scene depends upon the painted background which is introduced. The San Joaquin Valley group represents the broad, flat river valley with the Coast Range Mts. in the distance and illustrates the effects of irrigation in an arid country, not only upon the agriculture, but also upon the birds which the ample supply of food has induced to take up their residence in a region otherwise hostile to them. The Flamingo group represents a scene on an uninhabited island in the Bahamas, and has been developed from photographs, birds and accessories which were obtained there by Mr. F. M. Chapman, Associate Curator of Ornithology, last May and June, upon an expedition a summary account of which was given in the October, 1904, number of the JOURNAL. Mr. Chapman is the first naturalist to behold the flamingos in their home and to observe their nesting habits.

THERE has been installed in the new foyer, a representation of a part of the solar system, which is attracting considerable attention from visitors on account of its unique and instructive character. The sun is represented by an illuminated globe, six inches in diameter, and several of the planets are shown by means of lights of the proper comparative size placed at distances from

the globe representing the sun which correspond to the radii of their orbits. With a sun of the diameter chosen, it is possible to get only Mercury, Venus and the Earth into the foyer, which is 112 feet across. Mars is in the West Corridor and Jupiter is at the extreme end of the Wood Hall, 233 feet distant. The orbits of Saturn, Uranus and Neptune are so great that they cannot be gotten into the building on the scale selected for the sun. The light for Saturn would have to be placed out in the avenue, while that for Uranus would be twice as far away and that for Neptune would be more than a quarter of a mile from the sun's globe in the foyer, or nearly half-way across Central Park.

ACTING upon the request made by the New York City Teachers' Association, the Museum arranged a series of informal lectures for school children, which have been given by members of the scientific staff of the Museum on Monday, Wednesday and Friday afternoons during October, November and December. The subjects were selected by the Committee on Children's Interests of the Association, with the purpose of supplementing the regular class-room work. There were twelve lectures in all, each of which was given three times, covering topics in geography, history, astronomy and physiology, and they were given according to the schedule to be found on a succeeding page. At first it was believed that one of our small assembly rooms would be sufficient to accommodate the classes, but this proved entirely inadequate, and the lectures were adjourned to the large auditorium. The lectures have proved so popular that the auditorium has been filled to overflowing, and, in order to accommodate all the pupils who wished to attend the course, the Museum has given extra lectures on some of the topics. The children attend in classes, accompanied by their teachers. From twenty to thirty schools have been represented at each lecture, with from ten to two hundred pupils present from each. Classes have attended from schools from upper Manhattan and the Bronx, the lower East Side, Long Island City, Brooklyn and Staten Island. From October 1 to December 1, more than 20,000 children attended the lectures. The teachers have been warm

in their praise of this effort of the Museum to assist them, and many requests have been received that the course be continued in the spring. One teacher writes: "It is a great event for the little 'East Side' children to be taken to these lectures, and they always make special preparation days ahead. They heard the lecture on the American Indians October 28, and they have not ceased to talk about it. Every child has written a composition on the lecture."

MESSRS. G. H. Goss and H. D. Dodge of Waterbury, Connecticut, have given the Museum a choice lot of about 250 specimens of beetles collected by themselves on Mt. Kinabalu, British North Borneo.

MR. J. RHINELANDER DILLON has presented a fine nest of a wild honey-bee (*Apis mellifera*) built on the branch of a wild cherry tree.

SOME excellent wasps' nests from Brazil have recently been placed on exhibition.

A COLLECTION of butterflies and moths from the province of Yakutsk, Siberia, has been added to the collection.

THE exhibition collection of galls produced by insects has been rearranged and labeled in conformity with Guide Leaflet No. 16 on "The Insect Galls of the Vicinity of New York City."

DURING the past year the study collection of the Department of Entomology has been undergoing a complete rearrangement. The various collections which have been kept separate heretofore are being united so as to form a uniform series.

AMONG the instructive models which have been added to the series on exhibition in the Synoptic Hall, 107, are those of several Polyzoa and a huge *Synapta*. Several sponges have been mounted and tinted with the color of the living specimens as observed on the reefs of the Bahamas.

THE Department of Entomology recently received through the generosity of Mr. Samuel V. Hoffman a collection of about 3600 specimens of moths, principally from North America. This valuable addition contains many species new to our collection, as well as many other rare and desirable species.

THROUGH the kindness of Mrs. Edwin J. Benson of New York City, the Museum has obtained a series of 180 photographs from excellent negatives made by her during a particularly interesting trip in South America.

THE fine weather of Thanksgiving Day brought an unusually large number of visitors to the Museum, the total attendance that day being 7127. Much interest was manifested in the special exhibit of game birds appropriate to the day which was temporarily installed in the Main Hall on the second floor, and the auditorium was crowded to listen to a lecture by Dr. E. O. Hovey on "Russia—The Land and the People."

THE free lecture to the people on Christmas, Monday, December 26, was on "A Christmas Trip to the Tropics," and was delivered by Mr. F. M. Chapman to an audience which crowded the auditorium.

LECTURES.

MEMBERS' COURSE.

Thursday evenings at 8:15 o'clock.

The following programme was offered for the first part of the season 1904-1905:

November 17, 1904.—Dr. EDMUND OTIS HOVEY, "Russia—The Land and the People."

December 1, 1904.—Dr. WILLIAM MORTON WHEELER, "Shore and Island Life of the Bahamas."

December 8, 1904.—Mr. FRANK M. CHAPMAN, "The Home-Life of Flamingos."

December 15, 1904.—Prof. BASHFORD DEAN, "The Japanese—Their Social Life and Characteristics."

January 5, 1905.—Mr. LOUIS P. GRATACAP, "Mines, Quarries and 'Steel Construction.'"

January 12, 1905.—Prof. ALBERT S. BICKMORE, "Western Holland—Middleburg to Helder."

January 19, 1905.—Prof. ALBERT S. BICKMORE, "Eastern Holland—Utrecht to Gröningen."

The second course for the season will begin in February.

TEACHERS' COURSE.

The following lectures were given on Saturday mornings at 10:30 o'clock.

October 22.—Mr. FRANK M. CHAPMAN, "The Birds of Autumn and their Habits."

October 29.—Mr. FRANK M. CHAPMAN, "The most Profitable Methods of Bird Study for Teachers, Pupils and Bird Lovers."

November 5.—Dr. EDMUND OTIS HOVEY, "The Building of a Continent."

November 12.—Dr. EDMUND OTIS HOVEY, "The Physical Features of North America and their Origin."

November 19.—Mr. LOUIS P. GRATACAP, "How the Parks, Highways and Buildings of our City may be Used as Material for Nature Study."

November 26.—Mr. LOUIS P. GRATACAP, "The Industries of the Sea."

A second Course for Teachers will be given during the winter.

PEOPLE'S COURSE.

The following lectures were delivered Tuesday and Saturday evenings at 8 o'clock, in co-operation with the Department of Education of the City of New York.

Tuesdays:

October 25.—Dr. WILLIAM E. GRIFFIS, "Life in Korea."

November 1.—Mr. L. G. LEARY, "Syria and Palestine."

November 8.—Dr. WILLIAM E. GRIFFIS, "Street and Outdoor Life in the Mikado's Empire."

November 15.—Mr. FREDERICK A. NORTH, "Siberia."

November 22.—Dr. THOMAS P. HUGHES, "India."

November 29.—Mr. D. W. C. SNYDER, "How the People Live in Congo Land."

December 6.—Mr. GERHARDT C. MARS, "Cairo."

December 13.—Mr. FREDERICK E. PARTINGTON, "Morocco and Southern Spain."

Saturdays:

October 29.—Mr. ERNEST INGERSOLL, "Home and Society in Animal Life."

November 5.—Dr. LIVINGSTON FARRAND, "Primitive Culture and Types of Primitive Man."

November 12.—Dr. LIVINGSTON FARRAND, "Primitive Family Life and Organization."

November 19.—Dr. LIVINGSTON FARRAND, "Industrial Life: Hunting and Fishing."

November 26.—Dr. LIVINGSTON FARRAND, "Industrial Life: Fire-making, Pottery, Weaving."

December 3.—Dr. LIVINGSTON FARRAND, "Primitive Art."

December 10.—Dr. LIVINGSTON FARRAND, "Primitive Religions and Ceremonials."

The Free Lectures to the People will be resumed in January, 1905, according to the following programme:
Tuesday evenings at 8 o'clock:

January 3.—Prof. WALTER S. PERRY, "India: Life, Religion and Art of the Hindus."

January 10.—Prof. WALTER S. PERRY, "India under the great Mohammedan Conquerors: The Taj Mahal."

January 17.—Prof. WALTER S. PERRY, "Spain of To-day, and the Alhambra, the Fairy Palace of Moorish Art."

January 24.—Prof. WALTER S. PERRY, "Ceylon, 'The Pearl of India'; and Chinese Cities."

January 31.—Prof. WALTER S. PERRY, "Japan: The Life and Customs of Her Remarkable People."

February 7.—Dr. JOHN B. DEVINS, "Korea and Manchuria: The Land of the Morning Calm and the Gibraltar of China."

February 14.—Mr. ARTHUR STANLEY RIGGS, "The Real Filipino."

February 21.—Mr. ROLAND S. DAWSON, "Hawaii."

February 28.—Mr. L. G. LEARY, "Around the Historic Mediterranean."

Saturday evenings at 8 o'clock.

A course of eight lectures on Electricity by Professor CHARLES L. HARRINGTON.

January 7.—"Magnetism."

" 14.—"Statical Electricity."

" 21.—"Statical Electricity."

" 28.—"Dynamical Electricity."

February 4.—"Dynamical Electricity."

" 11.—"Dynamical Electricity."

" 18.—"Wireless Telegraphy."

" 25.—"Röntgen Rays: Becquerel Rays."

PUPILS' COURSE.

The lectures to the pupils of the public schools were given according to the following schedule. The lecturers were Messrs. L. P. GRATACAP, R. W. TOWER, E. O. HOVEY, H. I. SMITH and G. H. SHERWOOD of the scientific staff of the Museum.

Oct.

Mon. 3 31 28 A Little Journey in South America.

Nov.

Wed. 2 30 Physical Geography from Pictures.

Dec.

Fri. 7 4 2 Industries of the United States.

Mon. 10 7 5 New York City—Past and Present.

Wed. 9 7 7 Scenes in the Western Hemisphere.

Fri. 14 11 9 Methods of Transportation—Past and Present.

Mon. 17 14 12 The Planets.

Wed. 19 16 14 The Islands of the Sea.

Fri. 21 18 16 Our Wonderful Bodies.

Mon. 24 21 19 Distant Asia and Africa.

Wed. 26 23 21 A Trip through Europe.

Fri. 28 25 The American Indian.

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home will be continued throughout the quarter. Papers on technical and general scientific subjects are read before these societies. These papers are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences will hold its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Astronomy,
Physics and Chemistry.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Geology and Mineralogy.

Fourth Mondays.—Section of Anthropology and Psychology

On Tuesday evenings on varying dates meetings will be held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.



FIG. 1. RESTORATION OF MESONYX, A GIGANTIC CREODONT. UPPER EOCENE OF UTAH. BY CHARLES R. KNIGHT. AFTER OSBORN

FOSSIL CARNIVORES, MARSUPIALS AND SMALL MAMMALS

IN THE

AMERICAN MUSEUM OF NATURAL HISTORY.¹

BY W. D. MATTHEW, PH.D.

Associate Curator of Vertebrate Paleontology.

I. CARNIVORA.

THE Carnivora live principally on the flesh of other animals and have teeth and claws adapted to such food. Most of them, however, eke out their proper food, in times of scarcity, or for mere variety, with berries, nuts, bulbs and roots or even with grass, and some, at certain seasons, find little else available. Carnivores have large canine teeth adapted for cutting or for cutting and chewing, but never for grinding. All of them have claws, and they use their feet in a more varied way than do the Herbivora, for seizing and striking as well as for running and jumping. They walk either upon the entire sole of the foot (bears) or upon the under surface of the toes (dogs, cats etc.), never upon the tips of the toes as do the hoofed animals.

There are three divisions:

A, CREODONTA, OR PRIMITIVE CARNIVORA. Extinct land Carnivora with various primitive characters. None now extant.

B, FISSIPEDIA, OR TRUE CARNIVORA. Toes separate; terrestrial or amphibious; preying on land animals. Modern beasts of prey.

C, PINNIPEDIA, OR MARINE CARNIVORA. Web-footed, marine, fish-eating. Seals and Walruses.

Fossil land Carnivora are more numerous and varied than modern kinds. More than 250 fossil species have been described from the United States alone, while but 94 living species are recognized in this country. The majority of the fossil species

¹ This article forms No. 17 of the Museum series of **GUIDE LEAFLETS** and may be obtained in separate form.

fall into one or another of the living families and are more or less directly ancestral to the modern beasts of prey. The remainder belong to several extinct branches, not ancestral to any of the modern families, and are combined in the rather heterogeneous group of Creodonta. Seals and Walruses have not been found fossil, except in the most recent deposits, and nothing is known of their evolution.

A. CREODONTA, OR PRIMITIVE CARNIVORA.

In all modern Carnivora one tooth in the upper and one in the lower jaw are enlarged and especially adapted to the cutting of flesh. Each consists mainly of a high strong crest, or ridge,



FIG. 2. UPPER AND LOWER TEETH OF THE WOLF

Shows the carnassials or flesh-cutting teeth (the fourth premolar in the upper jaw, the first true molar in the lower)

and the two crests, or "blades," work against each other like the blades of a pair of scissors. These teeth are called the "carnassials," or flesh-teeth. In all the modern Carnivora the fourth (last) upper premolar and the first lower true molar are the carnassial teeth. The fossil species show the gradual evolution of this specialized tooth in the various families of Carnivores. In the Creodonta, on the other hand, there is either no carnassial tooth, or it is developed from other teeth of the series,—in one group the first upper and second lower true molars, in another the second upper and third lower molars. (Compare Figures 2, 3, 4 and 5.)

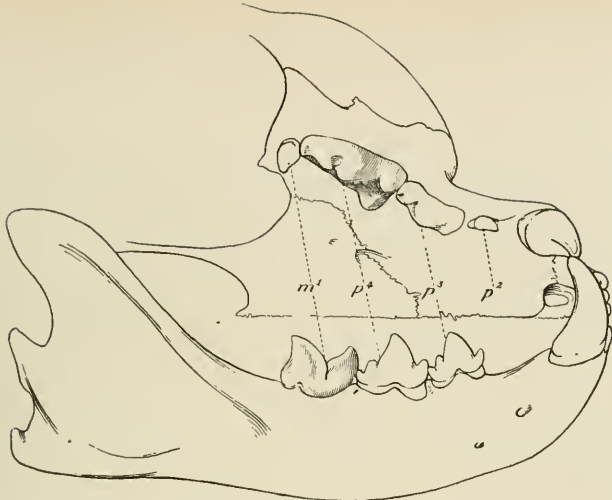


FIG. 3. UPPER AND LOWER TEETH OF THE LION
Shows the carnassials corresponding to those in the Wolf

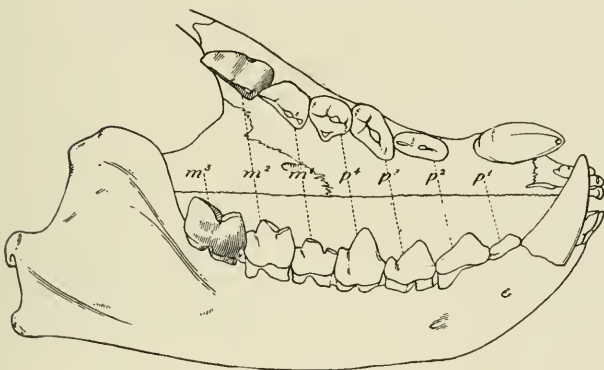


FIG. 4. UPPER AND LOWER TEETH OF HYÆNODON
Shows the carnassial teeth (second upper and third lower molar)

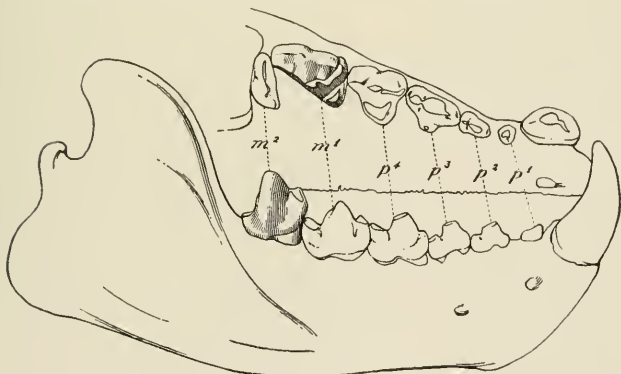


FIG. 5. UPPER AND LOWER TEETH OF OXYÆNA
Shows the carnassial teeth (first upper and second lower molar)

Another characteristic of all modern Carnivora is the union of two bones of the wrist, the scaphoid and lunar, which are distinct in most other animals. This gives additional strength to the thumb side of the very flexible wrist. In the Creodonts, these two bones were separate, and it is probable that they were separate in the earliest ancestors of the true Carnivores. Many

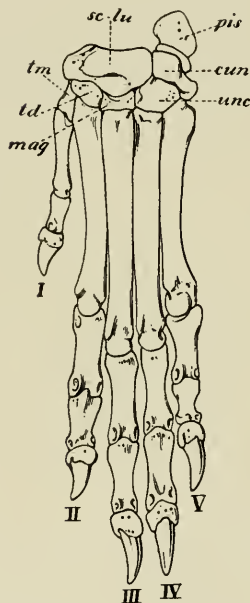


FIG. 6. FORE-FOOT OF THE WOLF
Shows the compact, slender foot, and the scaphoid and lunar bones of the wrist united (*sc-lu*) as in all true Carnivora

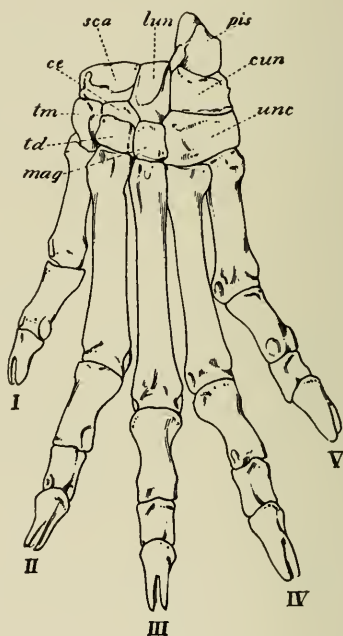


FIG. 7. FORE-FOOT OF HYÆNODON
Shows the shorter and less compact foot, and the separate scaphoid, centrale and lunar bones in the wrist (*sca, ce, lun*) as in all Creodonta

Creodonts also preserve a small extra bone, the "centrale," which is found now only in monkeys and in certain Insectivora and other small mammals. This bone seems to have been generally present in the ancient mammals.

The most ancient Creodonts are of especial interest to students, because they are thought to represent more nearly than any other fossils known, the central stock from which most modern mammals have descended. They appear already numerous

and varied, at the dawn of the Age of Mammals, and the different kinds become more and more specialized throughout the Eocene epoch. Meanwhile the true Carnivores appear in increasing numbers and gradually crowd out the Creodonts until the last of them has disappeared by the end of the Oligocene epoch. In their evolution the different Creodont groups specialized on much the same lines of development as those the true Carnivores took

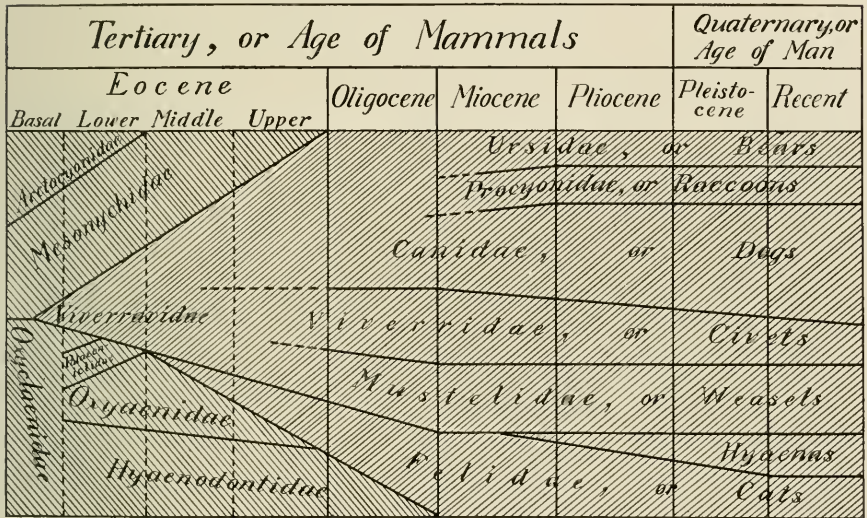


Diagram showing how the true Carnivora crowded out the Creodonta or Primitive Carnivora during the Tertiary Period.

 *Creodonta.*

 *True Carnivora.*

FIG. 8

afterwards. They were more or less wolf-like, weasel-like, cat-like or bear-like, according to the nature of their food and the manner of attacking their prey.

Fossil remains of flesh-eating animals are by no means as common as those of Herbivora, and the remains of Creodonts are especially rare, and mostly fragmentary. The great majority have been found in the Eocene fossil fields of the Western United States. This Museum is peculiarly rich in these rare and interesting fossils. Out of the 113 American species it possesses all the known specimens of 50 and the types or other good

specimens of 48 others (including three complete mounted skeletons), while only 15 species are not represented.



FIG. 9. UPPER AND LOWER TEETH OF TRICENTES

Represents the most primitive type of teeth of the Carnivora, with no specialized carnassials. Natural size

OXYCLÆNIDÆ.

Types: *Chriacus*, *Tricentes*, *Deltatherium*. Upper and lower jaws.

Small primitive animals with unspecialized teeth resembling those of lemurs. Only fragmentary specimens have been found, and but little is known about them. They are the most ancient group of the Creodonts and appear to have been nearest to the central stock from which the other Creodonts and Carnivores are descended. They are found only in the Basal Eocene.

ARCTOCYONIDÆ.

Types: *Arctocyon*, skull (cast); *Clænodon*, jaws and feet; *Anacodon*, jaws.

Bear-like omnivorous Creodonts with sharp canine teeth and the crowns of the molars flattened and wrinkled on the surface. The animal walked on the entire sole of the foot, and had large sharp claws like the modern bears. As in all these ancient mammals the brain was very small, as can be seen in the skull of *Arctocyon*.

PALÆONICTIDÆ.

Palæonictis, front of skull and jaws.

This rare and primitive group of Creodonts is thought by some authors to be the remote ancestor of the Cat family. It is found only in the Lower Eocene.

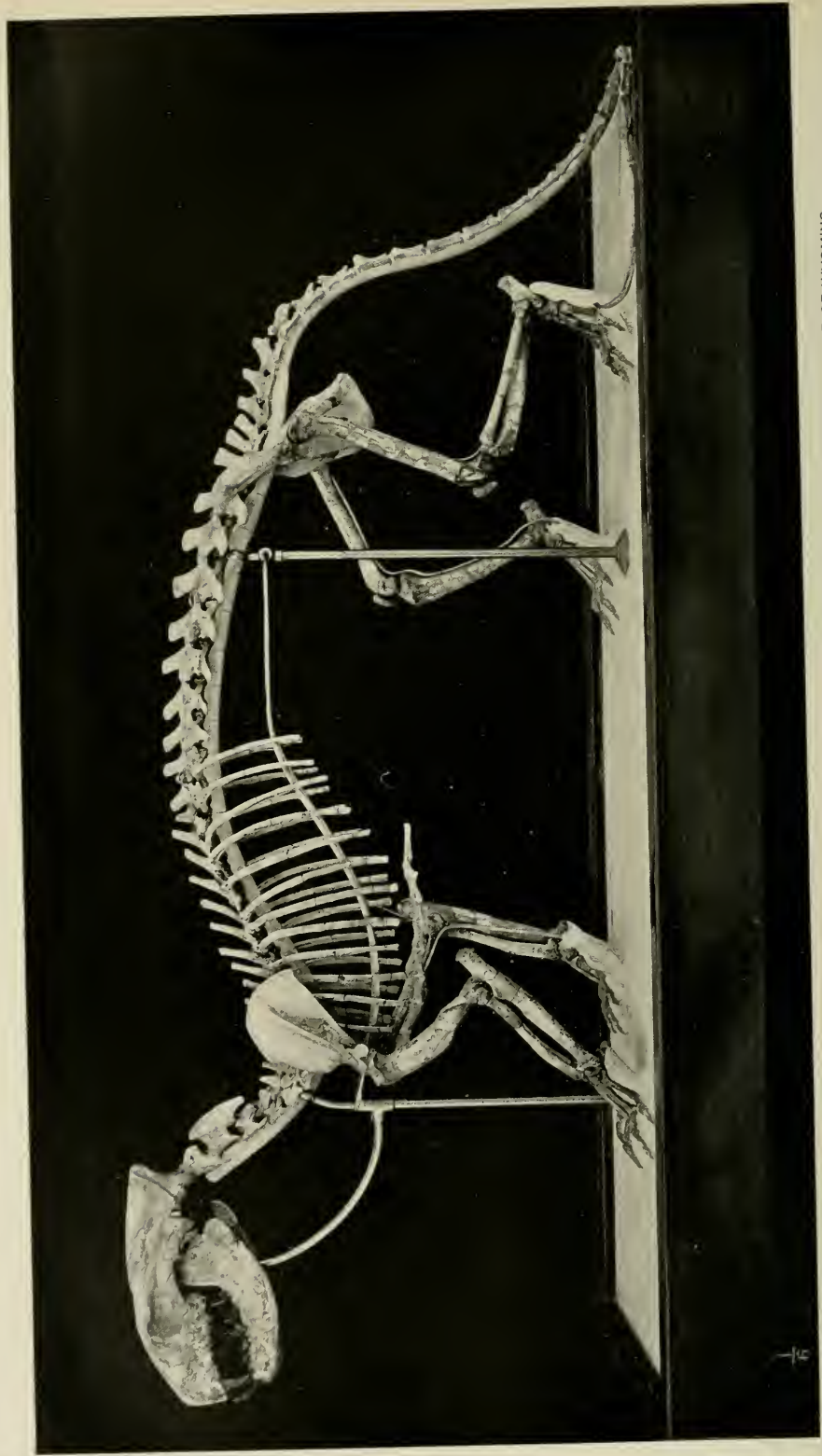


FIG. 10. MOUNTED SKELETON OF *OXYAENA LUPINA*, AN ANCIENT TYPE OF CREODONT FROM THE LOWER EOCENE OF WYOMING
One-sixth natural size. After Wortman

OXYÆNIDÆ.

Types: *Oxyæna* and *Patriofelis*, skeletons.

Somewhat resembling the larger Mustelines, such as the Otter and the Wolverine, with short heavy jaws adapted to seize and hold their prey, with long body and with short powerful limbs adapted for leaping, climbing or swimming, but not for swift running. The tail was extraordinarily long, and was larger than in any of the modern Carnivora. The teeth were adapted for flesh-eating, the first upper and second lower molar being enlarged and specialized for cutting the flesh. (See Fig. 5.)

Oxyæna, from the Lower Eocene, was about as large as a Wolverine. The head is disproportionately large, and the tail as long as the entire body and head. The brain-case is very small, and the space for jaw-muscles very large, the whole organization much inferior to that of modern flesh-eaters. Powerful and savage it no doubt was, but far from having the keen intelligence, speed and endurance of the Carnivora of to-day.

The mounted skeleton of this rare animal is due to a fortunate accident. In the Cope Collection there was an incomplete and fragmentary skeleton collected in 1881 in Northern Wyoming by Dr. J. L. Wortman. In 1891 Dr. Wortman, while collecting for this Museum in the same region, discovered another fragmentary skeleton, also incomplete. After the purchase of the Cope Collection by the Museum, these two specimens were compared and found to be parts of the same individual, together constituting a nearly complete skeleton, which has been mounted and placed on exhibition, with the missing parts restored in tinted plaster.

In *Oxyæna* the last upper molar has disappeared, and the second possesses a large shearing blade placed transversely to that of the first molar. In *Patriofelis* of the Middle Eocene the second molar has become very small, and all the flesh-cutting is done by the first molar, shearing against the second lower molar. The teeth are therefore a stage farther advanced in specialization.

The *Patriofelis* skeleton is composed of two individuals of the same species which were found at the same horizon and locality. The animal was about as large as a jaguar, and massively pro-

portioned, with short heavy limbs and broad blunt-clawed feet. It has been thought that *Patriofelis* was of aquatic habits, and more or less nearly ancestral to the Seals; but it was more probably terrestrial, as its teeth indicate adaptation to flesh food, not to fish eating. The limbs and face most nearly resemble those of the short-legged Mustelines, otter, mink etc., among modern animals, and some of these are aquatic or semi-aquatic; but this resemblance may be merely because in both animals the limbs are short and heavy.

HYÆNODONTIDÆ.

Types: *Sinopa*, skull and other parts; *Hyænodon*, skeleton and skulls.

Two groups of animals are included in this family, one represented by *Sinopa*, small long-bodied weasel-like animals with teeth little specialized, suggesting those of the Opossum, the other by *Hyænodon*, which was larger, proportioned more like the Tasmanian Wolf, with teeth highly specialized for flesh-cutting. The first group was probably arboreal, the second terrestrial in habit.

In *Sinopa*, which was characteristic of the Eocene, the crowns of the molars are triangular and each has a longitudinal shearing edge in front and one transverse. In *Hyænodon* of the Oligocene the transverse shear has disappeared completely, the longitudinal shear is concentrated especially on the third lower and second upper molar, the third upper molar has disappeared, and the teeth are as highly specialized for flesh-cutting as those of the living Cats. (See Fig. 3.)

Hyænodon lived during the Oligocene epoch and was the last survivor of the Creodonts. In proportions it singularly resembles the Thylacine, or Tasmanian Wolf, of the rough bush-land of Tasmania. The head is of very large size, with long jaws and large teeth, adapted to snapping rather than seizing and holding on to the prey. The feet had large, rather blunt claws, not retractile, and the animal appears to have walked on the toes, like the dogs and cats, not resting the sole on the ground as do the bears. (See Fig. 6.) A finely preserved skeleton and several skulls from the Big Badlands of South Dakota are mounted in the collection. The largest skull is nearly a foot long.

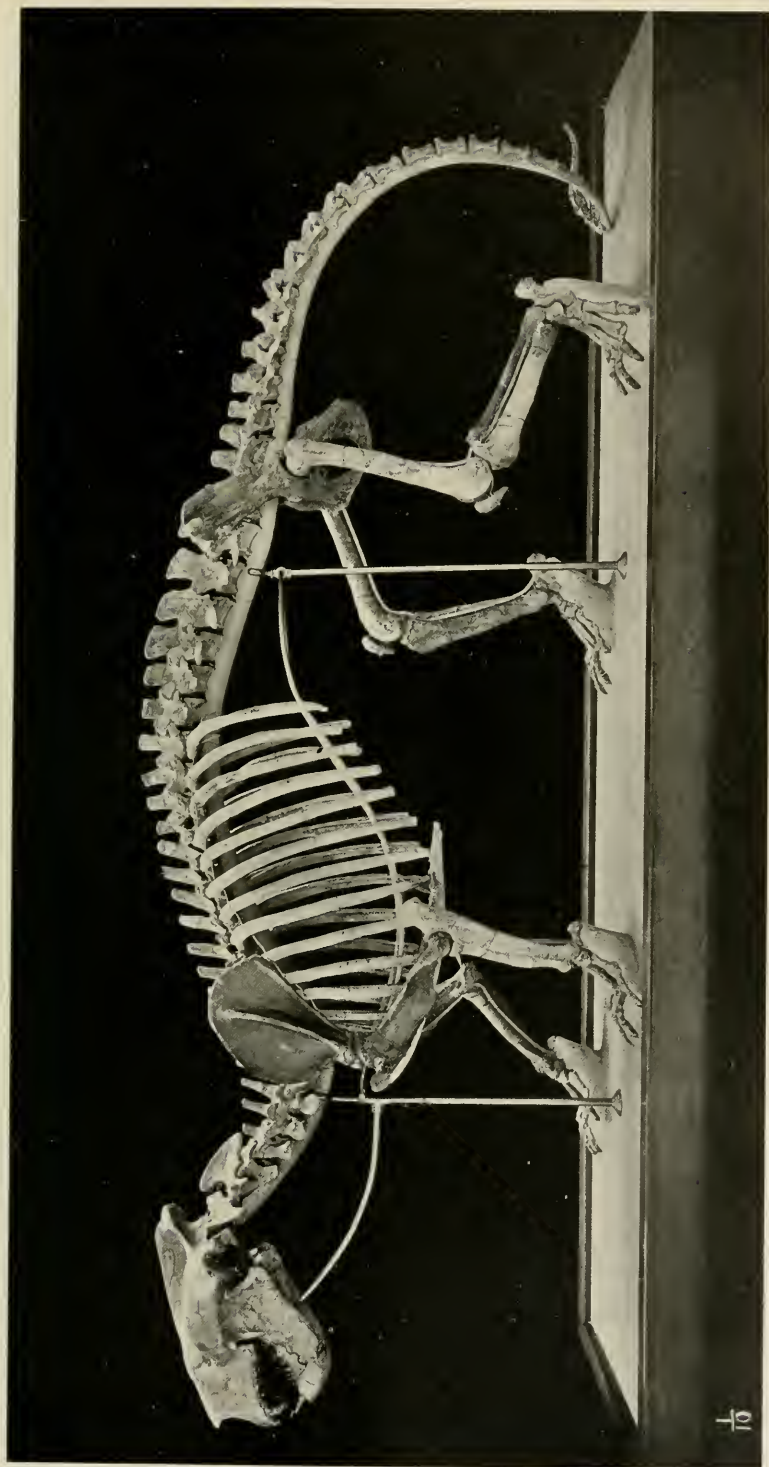


FIG. 11. MOUNTED SKELETON OF PATRIOFELIS FEROX, A CREODONT FROM THE MIDDLE EOCENE OF WYOMING
One-tenth natural size. After Osborn

MESONYCHIDÆ.

Type: *Mesonyx*, skull etc. Wall-case No. 6.

These animals had the limbs and feet specialized for swift running, and the feet tipped with flat hoof-like claws. The teeth are quite peculiar, they have no shearing edges, and the crown is composed of three rather high blunt-topped conical cusps. In

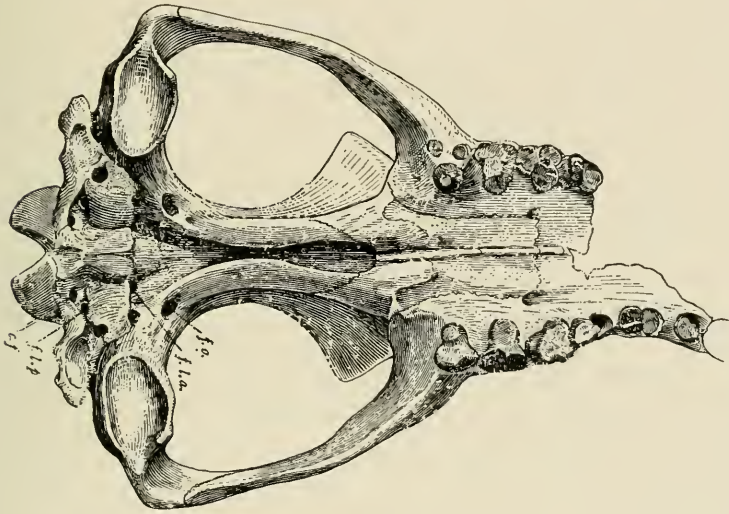


FIG. 12. SKULL OF MESONYX

Upper Eocene of Utah. After Osborn

the upper jaw these are in a triangle, one cusp inside, two outside; in the lower jaw they are in series, the central one being much the highest.

The Mesonychidæ are found in all the Eocene strata from the oldest to the youngest, and show a series illustrating the gradual evolution of their peculiar type of tooth. The massive blunt-cusped teeth, generally very much worn, suggest that they were used for crushing bones or other hard food, and that the animal fed upon carrion, like the modern hyæna. (See Fig. 1.)

B. FISSIPEDIA, OR TRUE CARNIVORA.

There are seven ¹ families of living Carnivora, four of which are cosmopolitan, being found in all the continents except Australia, while one (the Raccoons) is peculiar to America, and two (the Civets and the Hyænas) are peculiar to the Old World. The families are:

1. URSIDÆ, or Bears (Black Bear, Grizzly, Polar Bear etc.).
2. PROCYONIDÆ, or Raccoons (Raccoon and some rarer animals).
3. CANIDÆ, or Dogs (Wolves, Foxes, Jackals).
4. VIVERRIDÆ, or Civets (Civet, Mongoose etc.).
5. MUSTELIDÆ, or Mustelines (Weasel, Otter, Badger, Skunk etc.).
6. FELIDÆ, or Cats (Lion, Tiger, Leopard, Puma, Lynx etc.).
7. HYÆNIDÆ, or Hyænas.

The predaceous animals of Australia and the islands near to it are all Marsupials, or Pouched Mammals, except a wild Dog which was probably introduced by man. The range of the families of true Carnivora in former geological epochs was the same as now, except that South America had no true Carnivores until the Pliocene epoch, their place being taken by carnivorous Marsupials related to those which still inhabit Australia. In general the fossil true Carnivores are placed without difficulty in one or another of the families still surviving; but the earliest known ancestors of all these families were so much alike that it is hardly possible to say in which family they should be placed, and they are conveniently grouped together under the name of VIVERRAVIDÆ, or Ancient Civets, as the Civets among all the modern Carnivores are least altered from the primitive stock. As time went on these primitive Carnivora became more clearly differentiated, so that in the Miocene epoch all the modern families are easily distinguishable. (See Fig. 8.)

¹ Besides these seven families there are a few rare and peculiar Carnivora which are placed in families by themselves, but these are of no geological importance and need not be considered here.

URSIDÆ, OR BEARS.

The Ursidæ, or Bears, are the largest living Carnivora, and are not exceeded in size by any one of the extinct forms. They are less strictly carnivorous than most of the others, since they live in large part upon berries, nuts, roots and other vegetable food. The Polar Bear is an exception, feeding entirely upon animal food, fish and seals. Skulls of two extinct bears are shown in the collection, the Californian and European Cave-Bears.

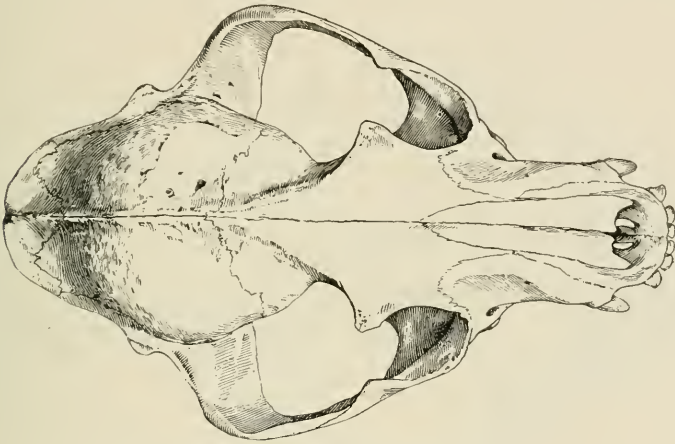


FIG. 13. TOP VIEW OF SKULL OF PHLAOCYON

A link between raccoons and primitive dogs. Lower Miocene of Colorado. Natural size

These get their name from the fact that their remains are chiefly found in caves, where they hibernated, probably, during the cold season, as do modern bears.

PROCYONIDÆ, OR RACCOONS.

The Procyonidæ are found only in North and South America, with the exception of the Panda of India, which is doubtfully referred to this family. Fossil raccoons very much like the living species are found in the Pleistocene strata of various parts of the United States, and in cave deposits. In the Oligocene and Miocene epochs lived two more primitive genera which

illustrate the evolution of these animals from the primitive civet-like Carnivora of the Eocene epoch. The Miocene stage, *Leptarctus*, is very little known; only a lower jaw and an upper tooth have been found. Of the Oligocene stage, *Phlaocyon*, a nearly complete skeleton was found in 1898, of which the skull, jaws, limbs and feet are on exhibition. This unique specimen is one of the best preserved fossil Carnivores in the collection. It is intermediate between the civet-like ancestors of the dogs (*Daphænus* and *Cynodictis*) and the modern raccoons. The

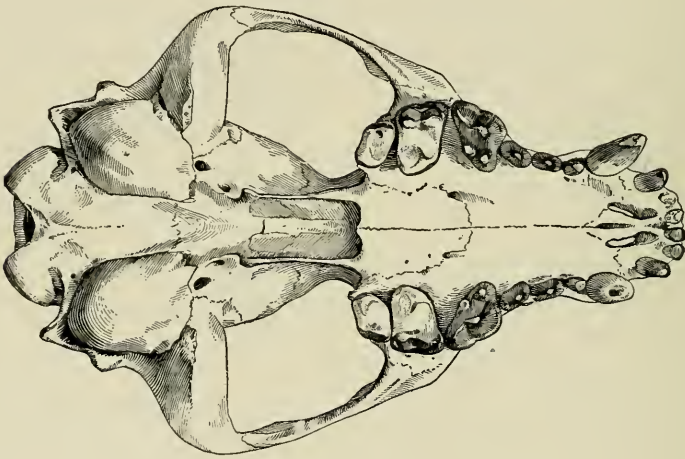


FIG. 14. UNDER SIDE OF SKULL OF PHLAOCYON

A link between raccoons and primitive dogs. Lower Miocene of Colorado. Natural size

shape of the skull is raccoon-like, but the number of teeth is the same as in the dogs, while their form is intermediate between the two types. The limbs and feet are also intermediate. It is probable, therefore, that the Dogs and Raccoons are derived from a common ancestral stock. Specimens found in Europe indicate that the Bears are likewise derived from this common stock, and that the three families have diverged, the Dogs becoming terrestrial flesh-eaters, living largely in open country, the Bears omnivorous and living in the woods, the Raccoons omnivorous and arboreal.

CANIDÆ, OR DOGS.

The living species of Canidæ—Wolves, Coyotes, Foxes—are found only in the most recent deposits (Pleistocene). A great variety of extinct species is known, some of which are the ancestors of modern forms, while others belong to side branches which have not survived. Most remarkable of these side branches were the Amphicyons or Bear-like Dogs, some of which were of huge size, equalling the modern Polar Bear—see skull and backbone of *Dinocyon* in wall-case No. 8. A large series of skulls of vari-

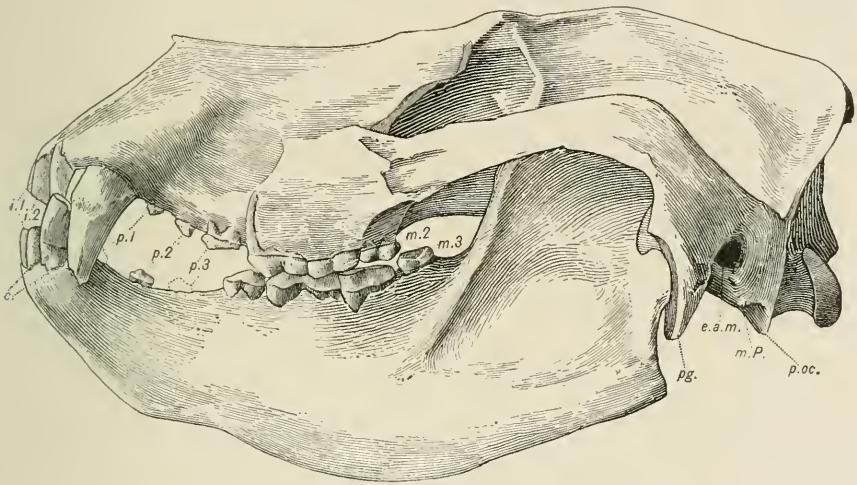


FIG. 15. SKULL OF DINOCYON

A gigantic extinct dog from the Upper Miocene of Texas. One-fourth natural size

ous extinct Dogs of the Oligocene and Miocene epochs is shown in the table-case. These indicate the evolution of the modern species from animals much more like the Civets in proportions and in the character of their teeth. It has been possible to trace out the probable direct lineage of at least two of the modern dogs, the Dhole of India, and certain South American foxes, through these North American fossil species. Other fossil species belong to races of Canids now extinct.

The increase in brain capacity from ancient to modern animals is well shown in this series of skulls. All ancient Dogs had small brains of inferior organization to their modern descendants.

VIVERRAVIDÆ.

Type: *Viverravus*, skull etc. Table-case.

The Viverravidæ resemble the modern Civets more nearly than any other modern Carnivora. They differ from them in fact in various primitive characters not very noticeable. The brain-case is much smaller in proportion; the scaphoid and lunar bones are sometimes not united; but the form and number of the teeth and proportions of the body were not different from those of modern Civets, except that the skull was larger and the limbs were shorter. They were probably the ancestors of the modern Carnivora, except the Cat family. (See Fig 8.)

VIVERRIDÆ, OR CIVETS.

A few specimens of fossil Civets from Europe are shown in the collection. They are not found fossil in America, but it is probable that they are descended, without much change in character, from the Viverravidæ shown in the opposite side of the same table-case.

MUSTELIDÆ. OR MUSTELINES.

Types: *Bunælorus*, *Plesictis*, *Mustela*, *Conepatus*, skulls.

The Mustelines are mostly small or of medium size, savage and blood-thirsty, solitary and forest-loving or aquatic. The Otters are aquatic and live mainly on fish; the Badgers are burrowing animals, and live mainly on burrowing rodents etc.; the Martens, Ferrets and Skunks are arboreal and terrestrial.

These different kinds of Mustelines seem to have separated as early as the Oligocene epoch, for even then we find Martens, Skunks and Otters distinguishable. But they were much more alike then than now, and all of them have many characters linking them with the Civets, indicating that the two families had a common origin. Compare the difference in teeth between *Bunælorus* and *Potamotherium* with the difference between their modern descendants the Marten and the Otter; also compare the *Bunælorus* teeth and skull with those of a civet. Note also the comparatively small brains of the Oligocene Mustelines as *Bunælorus* and *Plesictis*. Their Miocene descendants (*e. g.*, *Mustela ogygia*

skull) had larger brain capacity, and the modern forms still larger and better-developed brains. This indicates that slow but steady

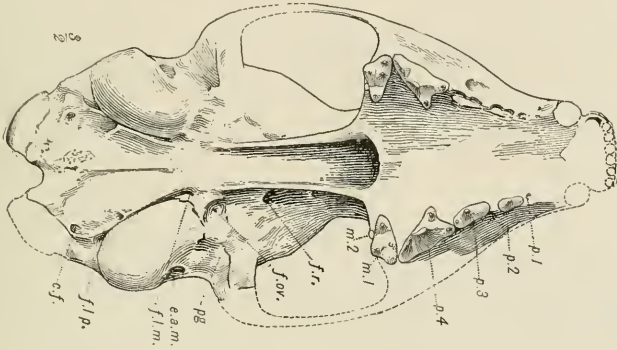


FIG. 16. SKULL OF THE PRIMITIVE MUSTELINE BUNÆLURUS

Oligocene of Colorado. Three-halves natural size. Viewed from the under side to show the teeth

increase in intelligence which has occurred in almost all the lines of evolution among quadrupeds. *Superiority of brain is the final test by which, in the long run, the persistence of a race is decided.*

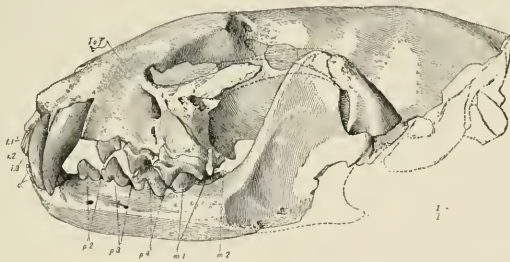


FIG. 17. SKULL OF MUSTELA OGYGIA

An extinct species of marten, from the Middle Miocene of Colorado. Side view, natural size

FELIDÆ, OR CATS.

(Sabre-Tooth Tigers)

Types: the mounted skeletons of *Smilodon* and *Hoplophoneus*, skeleton of *Dinictis* in block, skulls of *Hoplophoneus*, *Dinictis*, *Archælorus*.

Almost all the fossil Cats belong to a division now extinct, in which the upper canine teeth were enlarged into great curving, flattened, sharp-edged tusks, sometimes seven inches long.

Smilodon of the Pleistocene epoch was as large as a polar bear, and exceedingly muscular, especially in the great massive fore-limbs. The claws in the mounted skeleton (upright case) are larger than the largest lion claws. One of the great tusks is complete, the other was broken off during the lifetime of the



FIG. 18. THE GREAT SABRE-TOOTH TIGER, SMILODON
Pleistocene of South America. Restoration by Wolff. Courtesy of Dr. Elliott

animal, for the stump shows evidence of considerable wear after it was broken. This skeleton was found near Buenos Aires in Argentina along with the remains of gigantic ground-sloths (*Megatherium*) and tortoise-armadillos (*Glyptodon*) which may well have been the prey of this most terrible of all the Carnivora. But the *Smilodons* ranged all over the New World, and like the nearly allied *Machærodus*, which was distributed over all the northern continents, were contemporaries of primitive man. Whether our palæolithic ancestors ventured to contend with this gigantic foe, we do not know, but the structure of its skeleton indicates that, although more powerful than the lion and the

tiger, it was not nearly so active and intelligent, and that it was fitted to prey upon the slow-moving giant pachyderms of the Quaternary rather than upon active, alert and intelligent animals, least of all perhaps upon man. In the extinction of the Sabre-Tooth Tiger we may rather regret the passing away of a singular and magnificent type of the beasts of prey than rejoice over the disappearance of a dangerous enemy to the human race.

The ancestral Sabre-Tooth Tigers of the older geological epochs were smaller and less specialized. The skeleton of *Hop-*

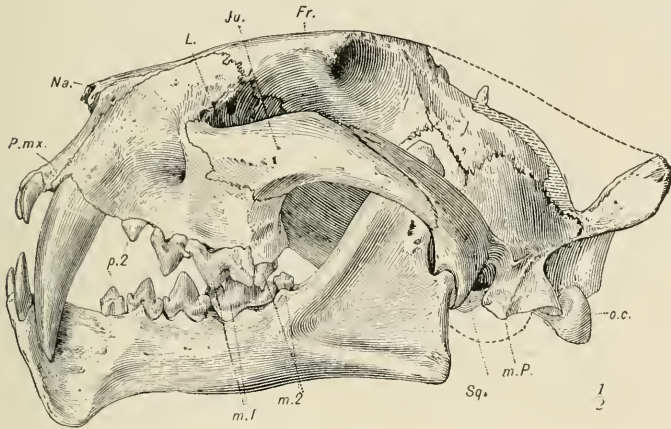


FIG. 19. SKULL AND LOWER JAW OF DINICTIS
Primitive Sabre-Tooth Tiger from the Oligocene of Colorado. One-half natural size

lophoneus illustrates their general character and size. This is the most perfect specimen in the collection, every bone being present, and all, with a few unimportant exceptions, complete and perfectly preserved. *Hoplophoneus* was proportioned somewhat like a leopard, but with shorter smaller limbs and very short spreading feet. *Dinictis* had longer limbs, but the teeth were less specialized. *Archalurus* and *Nimravus* were more primitive types, linking the Sabre-Tooth with the ancestors of the true Cats.

Habits of the Sabre-Tooth Tigers. The modern great Cats kill their prey usually by biting it in the neck so as to break the spinal column. They pursue as a rule the long-necked, thin-skinned

ruminants, which are the most abundant herbivores of to-day, seldom molesting the short-necked, thick-skinned pachyderms such as the rhinoceros and the elephant. The Sabre-Tooth appears to have used his great canine fangs in a quite different method of attack; the whole structure of the animal indicates that he struck them forcibly into the side of his prey, the mouth gaping wide meanwhile, and then presumably withdrew them with a ripping, tearing stroke, leaving a great gash whereby a



FIG. 20. THE HEAD OF SMILODON. OUTLINE RESTORATION
To show the widely gaping jaw. By Chas. R. Knight

large animal would soon bleed to death. By this method he would be peculiarly fitted to attack the great pachyderms, with which his exceptional muscular strength especially fitted him to cope while his lack of speed and agility would render him much less dangerous to the swift-footed ruminants and horses of the time. We may infer therefore that, while the true Cats were evolved to prey upon the larger swift running quadrupeds and developed speed and agility to catch their prey, the Sabre-Tooth was evolved to prey upon the powerful and massive contingent of the Herbivora, and developed enormous muscular strength and peculiar weapons of attack to cope with these animals.

The true Cats are not common as fossils, and our collections

contain only a few fragmentary specimens. They can be traced back as far as the Oligocene epoch, without any great change in character, but their earlier history is a blank. It appears probable that they are derived along with the Sabre-Tooth Tigers from some undiscovered group of Creodonts more nearly related to *Palæonictis* than to any other known fossil type.

HYÆNIDÆ, OR HYÆNAS.

Fossil Hyænas are common in the cave deposits of the Old World, but none have been found in this country. In the older formations of Europe there has been found a series of extinct forms which appear to connect the Hyænas with primitive Civets (*Ictitherium*, *Palhyæna*). These are not represented in our collections.

C. PINNIPEDIA, OR SEALS.

This group of Carnivora is exclusively adapted to marine life. They are found fossil in sediments of marine origin, but are very rare, and nothing is known of their evolution. They are almost unrepresented in our collections. An incomplete skull of an extinct species of Walrus found near Atlantic City, N. J., shows that the range of this animal formerly extended much farther south than now.

II. CHIROPTERA, OR BATS.

The Bats are the only mammals capable of true flight, although there are certain kinds of squirrels, marsupials and the so-called "flying lemurs," which can extend portions of the skin into a sort of parachute to assist them in taking long leaps from bough to bough. The wings of Bats are chiefly an extension of the skin membrane between the fingers, which are greatly elongated; those of birds on the contrary are chiefly composed of feathers which grow from the whole length of the arm and hand, although mainly from the second digit of the hand.

Fossil remains of Bats are exceedingly rare except in cave deposits, and do not teach us much about the evolution of this singular group of mammals. They resemble the Insectivora more than any other

order in teeth and skull, but we know practically nothing of when or how the great wing-membranes were developed, except that they must have been of very ancient origin, for in the Oligocene epoch this feature was as fully formed as now. A few fragmentary jaws and wing bones are shown in the collection.

III. INSECTIVORA.

Hedgehogs, Moles, Shrews etc. Table-case.

Small mammals of rather inferior organization with claws on the toes five digits on each foot, simple teeth with sharp cusps on the crowns and no gnawing teeth.

The Insectivora are an order of animals defeated and disappearing in the struggle for existence, owing to the superior

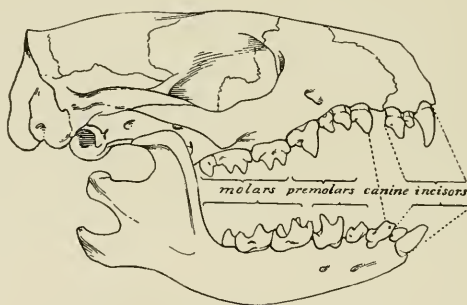


FIG. 21. SKULL OF THE HEDGEHOG.

A surviving type of the insectivora. Natural size

intelligence or better adaptation of their competitors. To escape utter destruction they have been forced into one or another peculiar mode of existence or method of defense, or have been driven to take refuge in the remoter corners of continents or in oceanic islands, where competition is less severe. The Hedgehogs have survived by virtue of their stout and efficient prickly coat, which deters almost any carnivorous animal from meddling with them. The Moles have taken refuge in the earth, where their rivals are few, and they are out of reach of most enemies. The Shrews are partly protected by their unpleasant odor, partly by their small size, nocturnal habits and burrowing or otherwise

concealing themselves. The other Insectivora are inhabitants of the larger tropical islands—Cuba, Madagascar and some East Indian islands—or of South Africa, but have disappeared from the great northern continents, Europe, Asia and North America, where the struggle for existence has been most severe and where all the higher types of mammals have been evolved.

The Insectivora are a very ancient order of mammals, and in past geological periods they were of more importance than now; in fact they have been considered by many scientists as representing more nearly than any other living order the primitive central group from which all other mammals have descended. Through the "Age of Mammals" they progressed less than most other orders and several families of them became extinct during that time, while the Moles and Shrews diverged from nearly similar habits to their present peculiarities, and the Hedgehogs, probably, acquired their coat of spines.

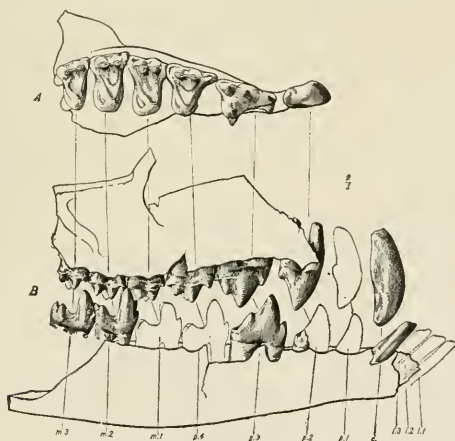


FIG. 22. ICTOPS ACUTIDENS

Upper and lower teeth, showing the "tritubercular" molars. Oligocene Epoch, Montana.
Twice natural size

LEPTICTIDÆ, OR PRIMITIVE HEDGEHOGS. Extinct.

Tritubercular molar teeth. Two incisors in upper dentition. Premolars unreduced, the last one molariform. Tibia and fibula fused, ulna and radius separate. Size and proportions like the modern

Hedgehog, skull long and pointed. Eocene and Oligocene epochs, North America.

A series of skulls of these little animals is shown in the table case. They differ from the true Hedgehogs in many archaic characters and there is no reason to suppose that they wore a prickly coat. The "tritubercular" teeth are a primitive characteristic.

ERINACEIDÆ, OR HEDGEHOGS. Living.

Quadritubercular molar teeth. Three incisors in upper dentition. Premolars often small, sometimes reduced in number, the last one molariform. Tibia and fibula united, ulna and radius separate. Skull rather short in the Hedgehog, long and pointed in certain allied East Indian animals. Oligocene to Recent epochs, Europe and America.

Part of the skull of a true Hedgehog of an extinct genus, *Proterix*, from the Oligocene of South Dakota, is shown in the table case, besides jaws of the Miocene genus *Galerix* from Europe.

TUPAJIDÆ, OR TREE-SHREWS.

Living. Borneo.

MACROSCELIDÆ, OR JUMPING-SHREWS.

Living. Africa.

SORICIDÆ, OR SHREWS.

Living. Europe, Asia, northern Africa and North America.

Incisors and premolars reduced in number, the incisors forming a pair of sharp-pointed pincers, molars quadritubercular. No zygomatic arch. Oligocene to Recent. Europe and North America.

More than half of the species of living Insectivora come under this family, but all are of small size, mostly nocturnal, hiding in burrows or beneath leaves or roots during the day. They feed on insects, for which purpose the pincer-like incisors and the sharp little cusps of the molar teeth are well adapted. Fossil Shrews are found in the Oligocene and later formations of both Europe and North America, but only fragmentary remains have been discovered. A few are on exhibition.

TALPIDÆ, OR MOLES.

Living. Europe, Asia, northern Africa and North America. Eocene to Recent in Europe and North America.

Completely subterranean; fossorial or burrowing. Incisors not pincer-like. A zygomatic arch present. Fore-limb very short and powerful, specialized for digging.

A small skull of a primitive Mole, *Proscalops*, from the Miocene of Colorado is on exhibition. It is Shrew-like in several respects, showing an approach between the now distinct families of Moles and Shrews. Other fragmentary remains of Moles are shown.

POTAMOGALIDÆ.

Living. Madagascar and West Africa. Aquatic animals with long eel-like tails.

SOLENDONTIDÆ.

Living. Cuba and Hayti.

CENTETIDÆ.

Living. Madagascar.

Fossil species supposed to be related to these animals are found in the Eocene (*Centetodon*) and Lower Oligocene (*Micro-*

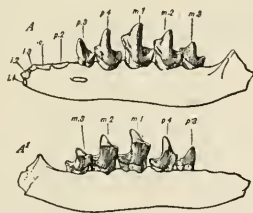


FIG. 23. MICROPTERNODUS BOREALIS

A small and primitive extinct insectivore. Lower jaw, inner and outer view, twice natural size. Oligocene Epoch, Montana

ternodus) of North America. This and the following family are more primitive than any other mammalia in the construction of their teeth.

CHRYSOCHLORIDÆ.

Living. South Africa.

These are known as Cape Golden Moles and take the place of the true Moles in South Africa. A fossil species has been found in the Miocene of Patagonia, indicating that they formerly inhabited both southern continents.

ADAPISORICIDÆ.

Extinct. Lower Eocene. France. Imperfectly known.

DIMYLIDÆ.

Extinct. Lower Miocene. Europe.

Only two molars in upper and lower jaw, the second quite small. Premolars reduced, no canine. Jaws are exhibited in the table-case.

IV. RODENTIA, OR GNAWERS.

Mice, Squirrels, Beavers, Hares, Porcupines etc.

Small mammals with claws on the toes, five digits on each foot, the teeth reduced in number, a pair of upper and lower incisors specialized for gnawing. The gnawing teeth grow continually from per-

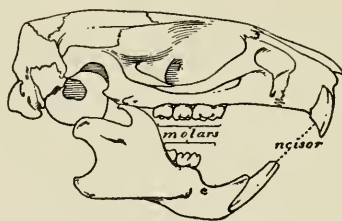


FIG. 24. SKULL OF THE RAT

The most familiar type of the rodentia. Natural size

sistent pulps, during the lifetime of the animal. They have enamel only on the anterior surface and wear to a chisel-like edge which is continually renewed by the more rapid wear of the dentine behind the enamel.

The Rodents are the most numerous group of mammals, but they are almost all small. There are probably now more different

species of rodents than of all the other mammals put together, and they are found in all sorts of places; some are terrestrial, others arboreal, others fossorial or subterranean, others amphibious. They live chiefly on vegetable food, such as grasses, fruit and nuts.

During the Tertiary period Rodents were probably equally numerous; but their remains are so small that they are apt to escape the attention of collectors. Even so they are among the most common of fossil mammals. Most of them belong to families still living.

MURIDÆ. Rats, Mice, Muskrats, Meadow-mice etc.

This is the largest group of the Rodents; there are more than 170 recognized species in North America alone. Several species have been found rather abundant in the American Badland formations. In the White River beds, *Eumys*, allied to the White-footed Mouse, is common; *Paciculus*, allied to the Wood-Rat, is found in the John Day beds; Muskrats and Meadow-mice occur in the Pleistocene.

GEOMYIDÆ. Pocket Gophers.

Found only in North America. Fossil Pocket Gophers occur in the John Day and later formations in the Western States.

HETEROMYIDÆ. Pocket Mice.

Found only in North America. Fossil Pocket Mice are rather common in the White River and John Day formations.

SCIURIDÆ. Squirrels, Prairie Dogs, Woodchucks etc.

Fossil Squirrels, not easily distinguishable from the modern forms, are found in the Oligocene and later formations of the United States. Prairie-Dogs occur in the Pleistocene.

HAPLODONTIIDÆ, OR SEWELLELS. Oligocene to Recent.

The Sewellel, or Mountain Beaver, is a peculiar little burrowing Rodent found only in the western Coast Region of North

America. A tiny fossil Rodent, *Meniscomys* of the Oligocene epoch, is thought to be ancestral to it.

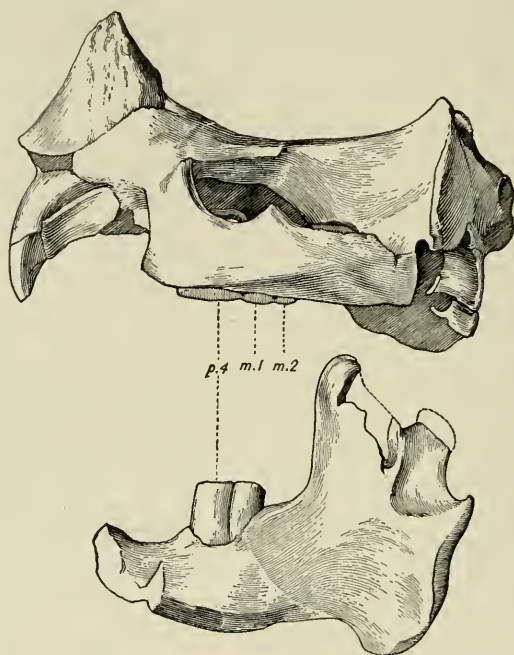


FIG. 25 THE HORNED RODENT, *CERATOGAULUS*
Skull and lower jaw. Middle Miocene of Colorado. Natural size

MYLAGAULIDÆ. Extinct. Miocene.

Curious little Rodents with digging claws on the fore-feet, very wide short head and peculiar teeth. One skull in the case, the *Ceratogaulus*, or Horned Rodent, shows a large boss indicating a horn on the nose, which gives it an odd likeness to a rhinoceros skull. They are very rare fossils, found only in North America.

CASTORIDÆ. Beavers. Oligocene to Recent.

Fossil Beavers of small size have been found in the Tertiary beds of both America and Europe and several skulls are shown in the collection. In the Quaternary beds are found remains of Beavers scarcely to be distinguished from the living species.

ISCHYROMYIDÆ

Extinct. Eocene and Oligocene.

These were Rodents with teeth more or less like Squirrels, but with skulls more like those of Porcupines and Beavers. They are more ancient than any living rodent families, for they were common in the Lower and Middle Eocene, while no other rodents appear until the Upper Eocene. Several skulls and parts of skeletons of *Ischyromys*, *Paramys* etc. are on exhibition.

CASTOROIDIDÆ.

Extinct. Pleistocene.

Intermediate between beavers and hystricomorphs, but of very large size. *Castor ohioensis* equalled a black bear in size. A skull and jaw of this rare animal are shown in wall case No. 8. Its remains are usually found in bogs, along with those of the mastodon.

SOUTH AMERICAN RODENTS.

All the extinct and most of the living Rodents of South America belong to a division more nearly related to the porcupine than to anything else. Some of the living ones, as the Paca and Capybara are of quite large size.

A series of skulls and jaws of extinct rodents from the Miocene of South America is exhibited in the table-case.

There are certain extinct European Rodent families which are thought to be more nearly related to the South American Rodents than to any others, and the remains of several of these forms are exhibited in the case for comparison beside them.

LEPORIDÆ. HARES AND RABBITS.

In the White River Badlands remains of fossil Hares are very abundant. They are more primitive than the modern species in the construction of the teeth, and are placed in the genus *Palæolagus* ("Ancient Hare"). In the later formations of America the rabbits belong to the modern genus *Lepus*.

LAGOMYIDÆ. Picas, or Tailless Hares.

These are little animals looking like small Rabbits, but have fewer teeth. They are found in high mountain regions in the Old World and likewise in western North America. They have

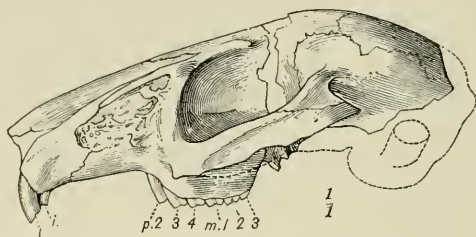


FIG. 26. SKULL OF PALÆOLAGUS
An ancestor of the hares. Oligocene of Colorado. Natural size

been found fossil in Europe, but in America occur only in the latest geological epoch; in the Old World they seem to have taken the place of the true Hares, which were limited to the New World until the end of the Tertiary period.

V. MARSUPIALIA.

All the living marsupials are inhabitants of Australia and the adjacent islands, except the Opossums and a rare genus of Rat-

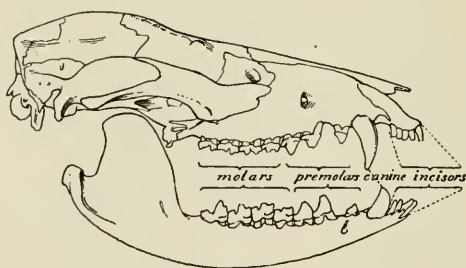


FIG. 27. SKULL OF THE OPOSSUM
Shows the peculiar dentition of the marsupials. Half natural size

Kangaroos from South America. In Australasia they take the place of the mammals of the other continents, none of which occurs

there.¹ Fossil marsupials related to the existing ones of the same region are found in Australia; one gigantic extinct Wombat, *Diprotodon*, is shown in case 6. In South America in the Miocene strata are found remains of various carnivorous marsupials and also of Rat-Kangaroos; a skull and other materials are shown in the collection. In the Eocene and Oligocene of Europe and North America, are found small jaws scarcely to be separated from those of the Opossum except by size. The primitive trituberculates of the Cretaceous period, in the table-case, may also have been marsupials.

VI. MULTITUBERCULATES.

This ancient group of mammals lived during the Age of Reptiles, and became extinct at the beginning of the Age of Mammals. Only jaws, teeth and other fragmentary remains have been found, and it is quite uncertain whether the group is related to the Marsupials or to the Monotremes (*Ornithorhynchus* etc.). Some resemble the Marsupial Rat-Kangaroos, others mimic the Rodents in form. The largest and best known is *Polymastodon* of the basal Eocene; the oldest shown in the case is the tiny *Ctenacodon* of the Jurassic period. *Chirox* and *Ptilodus* of the Cretaceous and basal Eocene are most like the Rat-Kangaroos.

VII. MESOZOIC TRITUBERCULATES.

A number of very small and fragmentary jaws and teeth of Trituberculates from strata of the Jurassic and Cretaceous periods of the Age of Reptiles are exhibited here. They are interesting because they are the most ancient of mammals and show the method of their evolution from reptilian ancestors. Some are thought to be related to the Marsupials, others more nearly to the Insectivores, but until more perfect specimens are found, little can really be stated with certainty about them. Enlarged models of three of these specimens are shown in the case, besides casts and original specimens of many more.

¹ The only exceptions are the dingo, or wild dog, which was probably introduced by man and a few small rodents and bats.

The *Dromatherium* and *Microconodon* casts and models represent two little jaws which are the oldest mammals known. They were found in the Triassic coal-beds of North Carolina, and have a type of teeth intermediate between the primitive three-cusped form of mammals and the simple one-cusped tooth of Reptiles.

THE ORIGIN OF MAMMALS.

The several groups of small and mostly primitive mammals which we have gone over in this guide-leaflet furnish a great deal of evidence, direct and indirect, as to the characters and appearance of the ancestral group or groups from which all mammals are supposed to be descended.

The most ancient mammals, the Multituberculates and Mesozoic Trituberculates of the Age of Reptiles, are known only from rare and very fragmentary remains and many more or less contradictory hypotheses have been advocated as to the relations of these little known groups to the Tertiary mammals which succeeded them and to the lower vertebrates (reptiles and amphibians) which preceded them in geological history. The consensus of present opinion is that mammals in general evolved from an unknown stock of reptiles most nearly related to the Theriodontia¹ which flourished at the end of the Palæozoic era; that they soon split into two branches, one of which (Monotremes) survives without very great change in the egg-laying mammals of Australia. The other more progressive branch again split, one division giving rise to the Marsupials, the other to the Placentals, the latter including all the remaining groups of mammals. The Multituberculates represent a side branch, but whether of Marsupials or of Monotremes is uncertain. The Trituberculates of the Mesozoic era were more nearly in the direct line; some appear to be in the Marsupial branch, others more doubtfully in the Placental branch. But all these conclusions are largely hypothetical.

When we come to the Tertiary mammals, we can speak much more certainly, as these are far more completely known. All the modern races of mammals, as we trace them back towards their

¹ Exhibited in the Hall of Fossil Reptiles, south side.

beginnings, approximate more and more towards a central type which is most nearly represented among known fossils by the earliest Creodonta (*Oxyckeniidæ*) of the dawn of the Tertiary. The Insectivora and Rodentia are also groups of mammals which in most respects have not departed very far from this primitive type. Its general characters are, (1) Small size; (2) Small brain of low organization; (3) Forty-four teeth of simple construction, with sharp cusps, the molars, premolars, canines and incisors of different form, the molars having the "tritubercular" pattern; (4) Limbs and neck flexible and of moderate length, tail very long and powerful, probably prehensile; (5) Feet with five digits on each foot, claws on the toes, the thumb more or less opposable.

These characters appear to indicate an arboreal mode of life rather than any other, and we may suppose that during the Age of Reptiles the ancestors of the mammals were tree-living animals, feeding chiefly upon insects. They were insignificant in size and unimportant in numbers, quite overshadowed by the great and numerous reptilian fauna which flourished during that long era. They possessed, however, the two most important elements of final success in the evolutionary struggle; a brain which, though inferior to that of their descendants, was superior to the brain of all other contemporary vertebrates, and a construction of the joints of limbs and feet more mechanically perfect than in any other animals. By the further improvement and elaboration of these factors of success, they were enabled to displace all their rivals, and become dominant upon land and to some extent upon the sea. Their invasion of the aerial province, already occupied by the highly developed and specialized birds, has been less successful, but of the once dominant reptile fauna of the land, almost nothing remains. The triumphant mammals have branched and re-branched, diverged into countless specializations in adaptation to peculiar modes of life, some of which have survived, while others have become extinct, but always the prime factors of success in the long run have been those which gave them their original advantage over their reptile competitors. Finally the truth that the supremacy in intelligence is first in importance, is best illustrated by the present dominance of man over the whole terrestrial world.

BIBLIOGRAPHY.

This Guide is based principally upon the various scientific studies of specimens in this collection, carried on mostly by members of the staff of this department, which have been published in the Bulletin and Memoirs of the Museum. Upon request, copies of these publications will be loaned to students and others interested in the subject of fossil mammals.

The following books are recommended for collateral reading:

1. *Popular descriptions of living animals.*

Stone and Cram. American Animals. Doubleday, Page & Co. New York, 1902.

Hornaday. American Natural History. Chas. Scribner's Sons. New York, 1904.

Flower and Lydekker. Mammals Living and Extinct. A. & C. Black. London, 1891.

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Flower. Introduction to the Osteology of the Mammalia. Macmillan & Co. London, 1885.

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Elliott. Synopsis of the Mammals of North America. Field Columbian Museum Publications. Chicago, 1901.

3. *Popular descriptions of extinct animals.*

Lucas. Animals of the Past. McClure, Phillips & Co. New York, 1901.

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Hutchinson. Extinct Monsters. D. Appleton & Co. New York, 1892.

Hutchinson. *Creatures of Other Days.* D. Appleton & Co. New York, 1894.

4. *Palæontology and geographical distribution.*

Smith-Woodward. *Vertebrate Palæontology.* Cambridge Natural Science Manuals, University Press. 1898.

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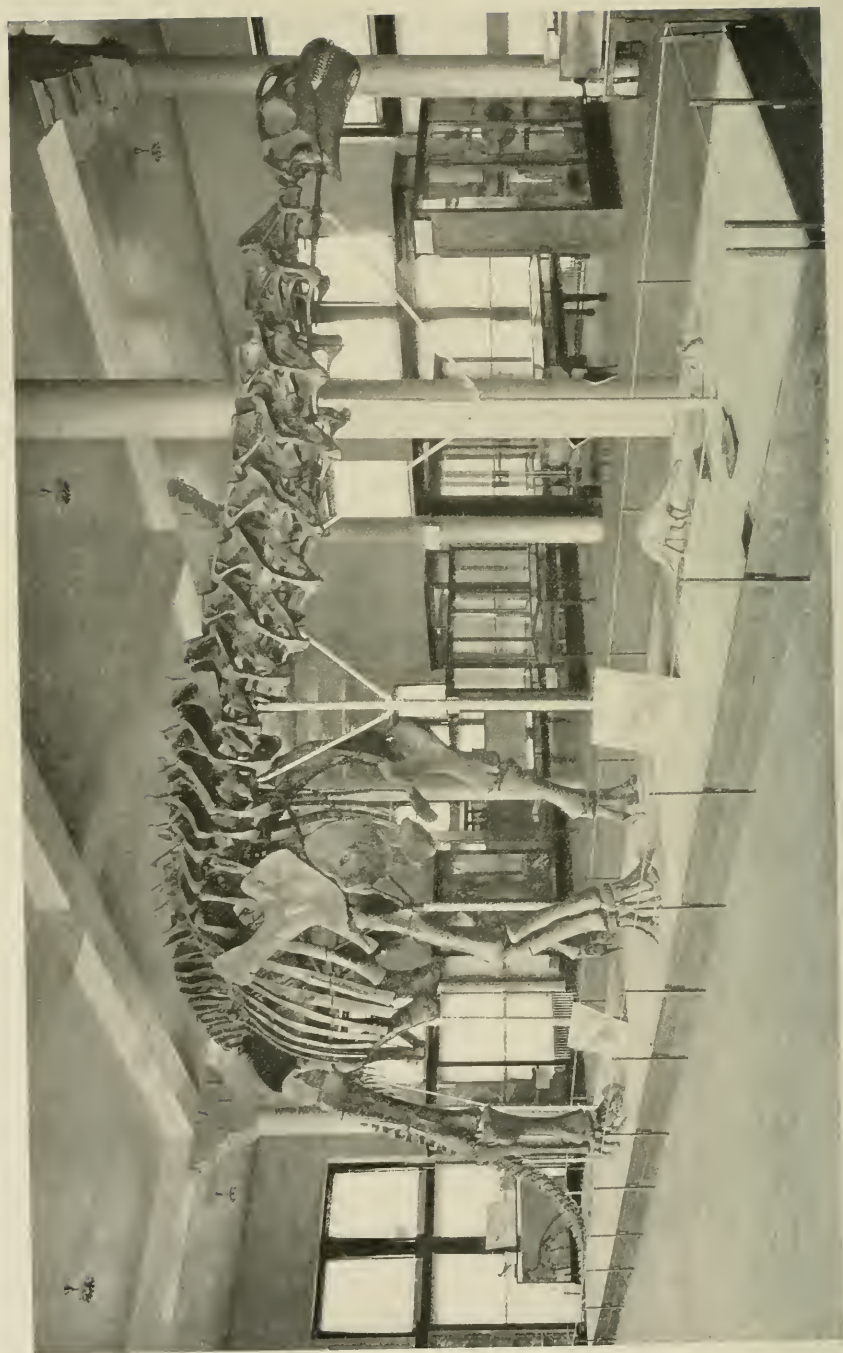


FIG. 1. MOUNTED SKELETON OF BRONTOSAURUS IN THE AMERICAN MUSEUM OF NATURAL HISTORY

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No. 2

THE MOUNTED SKELETON OF BRONTOSAURUS.

By W. D. MATTHEW.



EIGHT years ago the American Museum began a search for fossil reptiles in the Rocky Mountain States. The prime object of the search was to obtain skeletons of the Dinosaurs, those gigantic extinct animals whose fragmentary remains, discovered in that region and studied and described especially by the late Professor Marsh, have excited the greatest interest among men of science. In order to place these marvels of an antique world before the public in tangible form, a Dinosaur Hall was planned, in which should be exhibited mounted skeletons of the principal kinds of Dinosaurs. To obtain these, a series of expeditions into the regions of the arid West, where such fossils are to be found, was inaugurated and carried on under direction of Professor Osborn, and the collections of the late Professor Cope, containing three splendid skeletons of Dinosaurs, were purchased through the liberality of President Jesup.

This programme involved an amount of work hardly to be appreciated by outsiders, and it is as yet far from being complete. Nevertheless, the mounting of the largest skeleton, the Amphibious Dinosaur Brontosaurus, has been finished, the skeleton of a remarkable dwarf Dinosaur, the "Bird-Catcher," has been mounted and placed on exhibition, the preparation and mounting of entire skeletons of three other large and very extraordinary types (the Carnivorous, Duck-billed and Armored Dinosaurs) are well under way, and diligent search is being made for complete and mountable skeletons of other important kinds. Many other more fragmentary specimens have been found, some of which are exhibited in the wall-cases around the hall.

Visitors see here the largest fossil skeleton that has ever been mounted, and may obtain some idea of the variety and the extraordinary character of the animals which populated the earth during the Age of Reptiles, millions of years ago, before the Age of Mammals had begun or the various races of quadrupeds which now inhabit the world had commenced their evolution.

The Brontosaurus skeleton, the principal feature of the hall, is sixty-six feet eight inches in length, and stands fifteen feet two inches high. Its petrified thigh-bone weighs 570 lbs. The weight of the animal when alive is estimated at not less than ninety tons. About one-third of the skeleton, including the skull, is restored in plaster, modeled or cast from other incomplete skeletons. The remaining two-thirds belong to one individual, except for a part of the tail, one shoulder-blade and one hind limb, supplied from another skeleton of the same species.

The skeleton was discovered by Mr. Walter Granger, of the Museum expedition of 1898, about nine miles north of Medicine Bow, Wyoming. It took the whole of the succeeding summer to extract it from the rock, pack it and ship it to the Museum. Nearly two years were consumed in removing the matrix, piecing together and cementing the brittle and shattered petrified bone, strengthening it so that it would bear handling, and restoring the missing parts of the bones in tinted plaster. The articulation and mounting of the skeleton and modeling of the missing bones took an even longer time, so that it was not until February, 1905, that the Brontosaurus was at last ready for exhibition.

It will appear, therefore, that the collection, preparation and mounting of this gigantic fossil has been a task of extraordinary difficulty. No museum has ever before attempted to mount so large a fossil skeleton, and the great weight and fragile character of the bones made it necessary to devise especial methods to give each bone a rigid and complete support, as otherwise it would soon break in pieces from its own weight. The proper articulating of the bones and the posing of the limbs were equally difficult problems, for the Amphibious Dinosaurs, to which this animal belongs, disappeared from the earth long before the dawn of the Age of Mammals, and their nearest relatives, the living

lizards, crocodiles, etc., are so remote from them in either proportions or habits that they are unsatisfactory guides in determining how the bones were articulated, and are of but little use in posing the limbs and other parts of the body in positions that they must have taken during life. Nor among the higher



FIG. 2. SKELETON OF BRONTOSAURUS IN THE QUARRY

Showing three sections of the backbone partly covered with plaster bandages for transportation to the Museum. The ribs have already been removed from the near side of the backbone. Tools used in the work lie scattered about the quarry.

animals of modern time is there one which has any analogy in appearance or habits of life to those which we have been obliged by the study of the skeleton to ascribe to the Brontosaurus.

As far as the backbone and ribs were concerned, the articulating surfaces of the bones were a sufficient guide to enable us to pose this part of the skeleton properly. The limb-joints, however, are so imperfect, that we could not in this way make sure of having the bones in a correct position. The following method, therefore, was adopted:

A dissection and thorough study was made by the writer, with the assistance of Mr. Granger, of the limbs of alligators and

other reptiles, and the position, size and action of the principal muscles were carefully worked out. Then the corresponding bones of the Brontosaurus were studied and the position and size of the attachments of the corresponding muscles were marked out, so far as they could be recognized from the scars and processes preserved on the bone. The Brontosaurus limbs were then provisionally articulated and posed, and the position and size of each muscle were represented by a broad strip of paper extending from its origin to its insertion. The action and play of the muscles on the limb of the Brontosaurus could then be studied, and the bones adjusted until a proper and mechanically correct pose was reached. The limbs were then permanently mounted in these poses, and the skeleton as it stands is believed to represent, as nearly as study of the fossil enables us to know, a characteristic position that the animal actually assumed during life.

The Brontosaurus was one of the largest of the Amphibious Dinosaurs or Sauropoda, a race of gigantic reptiles which flourished during the Jurassic or Middle Period of the Age of Reptiles, —some eight millions of years ago by a moderate estimate of geological time. These Amphibious Dinosaurs are more ancient than any of the extinct mammals in the adjoining hall (No. 406), except for a few tiny jaws in the Small Mammal Alcove. They were the largest animals that ever lived, excepting some of the whales, and certainly were the largest animals that ever walked on four legs.

In proportions and appearance the Brontosaurus was quite unlike any living animal. It had a long thick tail like the lizards and crocodiles, a long flexible neck like an ostrich, a thick, short, slab-sided body and straight, massive, post-like limbs suggesting the elephant, and a remarkably small head for the size of the beast. The ribs, limb-bones and tail-bones are exceptionally solid and heavy; the vertebræ of the back and neck, and the skull, on the contrary, are constructed so as to combine the minimum of weight with the large surface necessary for attachment of the huge muscles, the largest possible articulating surfaces, and the necessary strength at all points of strain. For this purpose they are constructed with an elaborate system of

braces and buttresses of thin bony plates connecting the broad articulating surfaces and muscular attachments, all the bone between these thin plates being hollowed into a complicated



FIG. 3. MODEL OF BRONTOSAURUS. BY CHARLES R. KNIGHT, 1905
Executed from the mounted skeleton, under direction of Professor H. F. Osborn

system of air-cavities. This remarkable construction can be best seen in the unmounted skeleton of *Camarasaurus*, another Amphibious Dinosaur.

The teeth of the *Brontosaurus* indicate that it was an herbivorous animal feeding on soft vegetable food. Three opinions as to the habitat of Amphibious Dinosaurs have been held by scientific authorities. The first, advocated by Professor Owen, who described the first specimens found forty years ago, and supported especially by Professor Cope, has been most generally adopted. This regards the animals as spending their lives entirely in shallow water, partly immersed, wading about on the bottom or, perhaps, occasionally swimming, but unable to emerge entirely upon dry land. More recently Professor Osborn has advocated the view that they resorted occasionally to the land for egg-laying or other purposes, and still more recently the view has been taken by Mr. Riggs and the late Mr. Hatcher that they were chiefly terrestrial animals. The writer inclines to the view of Owen and Cope, whose unequalled knowledge of comparative anatomy renders their opinion on this doubtful question especially authoritative.

The contrast between the massive structure of the limb-bones, ribs and tail, and the light construction of the backbone, neck

and skull, suggests that the animal was amphibious, living chiefly in shallow water, where it could wade about on the bottom, feeding on the abundant vegetation of the coastal swamps and marshes, and pretty much out of reach of the powerful and active Carnivorous Dinosaurs which were its principal enemies.



FIG. 4. RESTORATION OF BRONTOSAURUS. BY CHARLES R. KNIGHT
This restoration represents Professor Osborn's view of the habits of the animal

The water would buoy up the massive body and prevent its weight from pressing too heavily on the imperfect joints of the limb- and foot-bones, which were covered during life with thick cartilage, like the joints of whales, seals and other aquatic animals. If the full weight of the animal came on these imperfect joints, the cartilage would yield and the ends of the bones would grind against each other, thus preventing the limb from moving without tearing the joint to pieces. The massive, solid limb- and foot-bones weighted the limbs while immersed in water, and served the same purpose as the lead in a diver's shoes, enabling the Brontosaurus to walk about firmly and securely under water. On the other hand, the joints of the neck and back are exceptionally broad, well-fitting and covered with a much thinner

surface of cartilage. The pressure was thus much better distributed over the joint, and the full weight of the part of the animal above water (reduced as it was by the cellular construction of the bones) might be borne on these joints without the cartilage giving away.

Looking at the mounted skeleton we may see that if a line be drawn from the hip-joint to the shoulder-blade, all the bones below this are massive, all above (including neck and head) are lightly constructed. This line then may be taken to indicate the average water-line, so to speak, of this Leviathan of the Shallows. The long neck, however, would enable the animal to wade to a considerable depth, and it might forage for food either in the branches or the tops of trees or, more probably, among the soft succulent water-plants of the bottom. The row of short, spoon-shaped, stubby teeth around the front of the mouth would serve to bite or pull off soft leaves and water-plants, but the animal evidently could not masticate its food, and must have swallowed it without chewing, as do modern reptiles and birds.

The brain-case occupies only a small part of the back of the skull, so that the brain must have been small even for a reptile, and its organization (as inferred from the form of the brain-cast) indicates a very low grade of intelligence. Much larger than the brain proper was the spinal cord, especially in the region of the sacrum, controlling most of the reflex and involuntary actions of the huge organism. Hence we can best regard the Brontosaurus as a great, slow-moving animal-automaton, a vast store-house of organized matter directed chiefly or solely by instinct and to a very limited degree, if at all, by conscious intelligence. Its huge size and its imperfect organization, as compared with the great quadrupeds of to-day, rendered its movements slow and clumsy; its small and low brain shows that it must have been automatic, instinctive and unintelligent.

COMPOSITION OF THIS SKELETON.

The principal specimen, No. 460, is from the Nine Mile Crossing of the Little Medicine Bow River, Wyoming. It consists of the 5th, 6th and 8th to 13th cervical vertebræ, 1st to 9th dorsal and 3d to 19th caudal vertebræ, all the ribs, both coracoids, parts of sacrum and ilia, both ischia and pubes, left femur

and astragalus and part of left fibula. The backbone and most of the neck of this specimen were found articulated together in the quarry, the ribs of one side in position, the remainder of the bones scattered around them, and some of the tail-bones weathered out on the surface.

From No. 222, found at Como Bluffs, Wyo., were supplied the right scapula, 10th dorsal vertebra, and right femur and tibia.

No. 339, from Bone Cabin Quarry, Wyo., supplied the 20th to 40th caudal vertebrae; No. 592, from the same locality, the metatarsals of the right hind foot, and a few toe-bones are supplied from other specimens.

The remainder of the skeleton is modeled in plaster, the scapula, humerus, radius and ulna from the skeleton in the Yale Museum, the rest principally from specimens in our own collections. The modeling of the skull is based in part upon a smaller incomplete skull in the Yale Museum, but principally upon the complete skull of *Morosaurus* shown in Case 42.

Mounted by A. Hermann; completed Feb. 10, 1905.

TWO NEW BIRD GROUPS.



THE recently completed group of Flamingos and of the summer bird-life of the San Joaquin Valley of California, photographs of which are reproduced on pages 71 and 77, more closely approach the Museum's ideal of an exhibit illustrating the haunts and nesting-habits of birds than any which have heretofore been prepared.

Both are based upon careful field studies, by artist as well as by ornithologist, and both accurately portray not only the home-life of the species they represent, but also, through the use of a painted background, the character of the region in which the birds live.

Aside from their beauty, which renders them attractive to the most casual observer as well as to the ornithologist, these groups possess much scientific value. This is particularly true of the Flamingo group, in which the nesting-habits of this bird are for the first time properly shown.

These two groups make important additions to the series already prepared through the generosity of several friends of the Museum, who have contributed to a fund designed for this purpose.

By no means the least important feature of the Museum's expedition to the Bahamas in search of material for the Flamingo



THE FLAMINGO GROUP
Background painted by Charles J. Hittell (landscape) and Louis Agassiz Fuertes (birds). Birds mounted by Herbert Lang

group is the influence exerted by the Museum toward the enactment of a law which has just gone into effect establishing a close season on the Flamingo and other birds which formerly were without legal protection in the colony, and prohibiting the killing of song and insectivorous birds at any season.

MUSEUM NEWS NOTES.



LARGE part of the Philippine exhibit of the St. Louis Exposition has been acquired by the Museum, subject only to a gift of certain duplicate material to the Smithsonian Institution and to the Commercial Museum of Philadelphia.

When packed, ready for shipment, the material thus acquired filled twenty freight cars. All visitors to the exposition will realize that this acquisition is a matter of the highest importance not only to the Museum and to the city; but to the country at large, and that it places here the most comprehensive single collection representing the life and industries of any of the groups of Pacific islands.

The material has arrived at the Museum and a small portion of it has been arranged for temporary exhibition in the North and West Wings of the second floor of the building, but there is material enough to fill an entire wing of the building without duplicating exhibits. The present temporary installation enables the visitor to gain a very good summary idea of the culture of the important tribes inhabiting the islands. Clothing and textile fabrics, household utensils, agricultural implements, fish and game traps, arms, houses, boats and other means of transportation and articles of manufacture, all find their place here in ample illustration. The Museum, furthermore, is exhibiting part of the original material at the Lewis and Clark Centennial Exposition at Portland, Oregon. The Portland exhibit will come to the Museum at the close of the exposition.

J. PIERPONT MORGAN, ESQ., has lately added to the gem collection material representing forty-one mineral species used or available for use as gems. Among the cut stones are some

remarkable rubellites and other California tourmalines, and some choice beryls and topazes. Two superb kunzites, one of 224 karats and the other of 118 karats, add brilliancy to the display of that peculiar new gem. Some new gold specimens are worthy of special mention. The installation of the gem collection has been entirely remodeled, greatly to the improvement of its effectiveness. The floor space of the whole corridor is now devoted to the gems and gem material, each species having a special pedestal case devoted to its proper display. The change in the installation of the gems has necessitated the temporary removal and storage of some of the finest exhibition portions of the mineral cabinet, but they will be displayed again as soon as room can be made for them.

MR. MORGAN has also presented to the Museum the George F. Kunz collection of meteorites, which has been on exhibition for some years as a loan. The collection comprises some rare specimens, including two which are unique and have never been described, and the largest mass (1038 pounds) of Cañon Diablo which has been found.

THE mineral cabinet has been enriched by the acquisition of several rarities from the noted Biunenthal locality in the Tyrolean Alps. Among the species and varieties received may be mentioned bementite, hutchinsonite, smithite, trechmannite and lengenbachite. A remarkable antique jade labret is one of the recent additions to the collection.

THE appearance and usefulness of the local collection of the New York Mineralogical Club have been greatly enhanced by the substitution of neat printed labels for the previous type-written cards.

THE Department of Conchology has received from Mr. F. A. Constable a gift of the last installment of the celebrated Hirase collection of the land shells of Japan, and the series is now on its way to the Museum. This installment comprises about 1000 specimens of shells belonging to 220 species, bringing the total of the Hirase collection in the possession of the Museum up to

about 4000 specimens of 800 species. The series is fully representative of the land molluscan fauna of Japan, and while the specimens are not strikingly beautiful, they are of high scientific interest.

A LARGE proportion of the radium exhibit gotten together for the St. Louis Exposition by the United States Geological Survey has been presented to the Museum and has been temporarily installed in the Hall of North American Mammals (No. 206). The exhibit consists of minerals containing uranium, polonium, radium, actinium and other radio-active minerals; compounds and apparatus illustrating the various steps in the process of manufacture, and photographs and literature bearing upon radio-activity. The principal source of radium is pitchblende from Joachimsthal, Bohemia, but it has also been derived from carnotite, a Colorado mineral, and it occurs widespread in minute quantities. This exhibit attracted great attention at the exposition and is the object of much study by visitors to the Museum.

ANOTHER of the exhibits from the St. Louis Exposition which have been received at the Museum is the material that was sent out by the New York City schools. This exhibit has been temporarily arranged in the East Hall of the second floor (No. 207) and has been visited by thousands of school children and their parents.

A MODEL representing a village of the Koryak tribe of eastern Siberia has been completed by the Department of Ethnology and placed on exhibition in the West Hall of the ground floor. The model represents not only the half-underground houses with their strange hopper-shaped superstructures, but also the industries of the people and the preparation of their store of food for the long winter. The season represented in the group is the autumn.

THROUGH the courtesy of the Oregon Historical Society of Portland, the Museum has had the opportunity of studying, photographing and making casts of an important series of

archæological specimens, mostly from the region between The Dalles and the mouth of the Willamette River. There were fifty-six specimens, comprising implements and other objects in carved stone of several kinds. Such sculptures are rare so far north in America, while several of them are quite unique and are new to archæologists. This loan has enabled the Museum practically to complete its data regarding known specimens from this archæological province.

ON February 17 the new Dinosaur Hall of the Department of Vertebrate Palæontology was opened to the public. The principal object in this hall is the great skeleton of *Brontosaurus*, an enormous herbivorous animal distantly related to the lizards. A detailed description of this specimen, the only exhibit of its kind in the world, is given in another part of the present issue of the JOURNAL. The other great families of dinosaurs (the Carnivorous, the Horned, the Armored and the Spoon-billed) will all be represented in this hall. On the south side of the room have been installed several magnificent specimens of fossil turtles and tortoises from the Cretaceous beds of the West. The specimens for the Dinosaur Hall have been derived from the collections made by the Museum field expeditions from 1897-1904, which have been presented by the Trustees, and the E. D. Cope Collection of Reptiles, Amphibians and Fishes, which was presented to the Museum in 1902 by President Jesup.

The Tower Room has been set aside for the reception of the collection of fossil fishes which is now in process of installation. The principal portions of this collection are the famous Newberry Collection deposited with the Museum by Columbia University; the Cope Collection presented by President Jesup, and an extensive series from Syria.

Over the arch leading into the Morgan Hall of Mineralogy, the Department of Vertebrate Palæontology has installed the giant fish known as *Porthius* from the American Mediterranean Sea of the Cretaceous period.

THERE has recently been placed on exhibition in the Hall of Fossil Mammals a representative series of the remarkably rich



THE SAN JOAQUIN VALLEY GROUP

Background painted by Charles J. Hittell (landscape) and Louis Agassiz Fuertes (birds). Birds mounted by H. S. Denslow

extinct fauna collected in caves in Arkansas by Messrs. Walter Granger and Barnum Brown in 1903 and 1904, on expeditions sent into the region by the Museum.

EARLY in March, Mr. Frank M. Chapman, Associate Curator of Ornithology, went into the swamps of Florida for the purpose of studying the life history of the Brown Pelican and of obtaining additional material for the group illustrating this remarkable bird. He reports exceptional success in attaining the objects of the expedition. He has also obtained data, photographs and specimens with which to represent the nesting-habits of Ward's Heron, the Water Turkey and other birds, greatly enriching our Museum and study collections.

IN commemoration of Audubon's one hundred and twenty-fifth birthday, the Museum has placed on exhibition in Hall No. 308, a collection of Audubon relics. Among the objects is the portfolio in which Audubon carried specimen plates while securing subscribers to his great work in this country and abroad, together with sketches and finished plates. Here are also his gun and hunting coat, and the dog harness used in Labrador, mementoes of the journey to the then Far West.

DR. E. O. HOVEY, Associate Curator of Geology, went to Mexico early in February on a geological expedition through the practically unknown Sierra Madre mountain region of western Chihuahua. He reports visiting a wonderful series of cañons, from 2000 to 6000 feet in depth and from 5 to 11 miles in width, which have been carved by the rivers out of the elevated plateaus forming the major portion of the state. Dr. Hovey has also visited the great copper mines at Bisbee, Arizona, and Nacozari and Cananea, Sonora, Mexico. The specimens collected from these mines, as well as from the region traversed in the main expedition, will form valuable additions to our series illustrating economic and mining geology. Hundreds of negatives form an important part of the results of the expedition. Professor Robert T. Hill, formerly of the United States Geological Survey, is the leader of the party.

LECTURES.

MEMBERS' COURSE.

THE second course of lectures to members of the American Museum of Natural History by officers of the scientific staff of the Museum was given according to the following programme:

Thursday evenings at 8.15 o'clock.

February 2.—PROF. A. F. BANDELIER, "The Traveling Indian Medicine Men of Bolivia."

February 9.—PROF. LIVINGSTON FARRAND, "Religious and Ceremonial Life of the North American Indians."

February 16.—PROF. MARSHALL H. SAVILLE, "Ruins of Mayan Cities in Central America."

February 23.—MR. GEORGE H. PEPPER, "Explorations in the Southwest and in Mexico during 1904."

March 2.—MR. GEORGE H. SHERWOOD, "The Game and Food Fishes of Our Atlantic Coast."

March 9.—PROF. WILLIAM MORTON WHEELER, "The Habits of Ants."

March 16.—PROF. ALBERT S. BICKMORE, "Northern Germany—Bremen, Hamburg and Lübeck."

March 23.—PROF. ALBERT S. BICKMORE, "Southern Germany—Stuttgart, Nuremberg and Rothenburg."

PUPILS' COURSE.

DURING the spring and summer terms of the public schools the lectures at the Museum to the pupils have been continued according to the schedule which follows. These lectures, which are intended to supplement the regular grade work in geography are so popular with teachers and classes that it is necessary to use the Auditorium for the whole course. The lecturers are Messrs. L. P. Gratacap, R. W. Tower, W. M. Wheeler, E. O. Hovey, H. I. Smith, G. H. Sherwood, G. H. Pepper and Barnum Brown of the scientific staff of the Museum.

	Mar.	Apr.	May.	
Mon.	6	3	8	"Russia and Japan."
Wed.	8	5	10	"The Capitals of Europe."
Fri.	10	7	12	"The Industries of the United States."
Mon.	13	10	15	"The American Indian."
Wed.	15	12	17	"In Polar Regions."
Fri.	17	14	19	"Spanish America."

	Mar.	Apr.	May.	
Mon.	20	24	22	"The Physical Divisions of the United States."
Wed.	22	26	24	"Egypt and her Neighbors."
Fri.	24	28	26	"Our Island Possessions."
		May		
Mon.	27	1	29	"Methods of Transportation—Past and Present."
Wed.	29	3	31	"The Work of Water."
		June		
Fri.	31	5	2	"New York City—Past and Present."

COLUMBIA UNIVERSITY—MUSEUM COURSE.

DURING February, PROF. HENRY FAIRFIELD OSBORN, Curator of Vertebrate Palæontology in the Museum and Da Costa Professor of Zoölogy in Columbia University, delivered a course of six illustrated lectures on "The Evolution of the Horse," in co-operation between the Museum and Columbia University. The programme of the lectures was as follows:

Wednesday, February 1.—"The Horse as an Animal Mechanism."

Adaptation of the teeth, skull, skeleton, musculature and internal anatomy to the special functions of grazing and of speed.

Monday, February 6.—"The Horse in Relation to the Idea of Evolution."

The chief facts in the evolution and geographical distribution and the special relation of horses to their environment.

Wednesday, February 8.—"The Fossil History of the Horse, especially in North America."

Supposed ancestors of the horse in the Cretaceous and Basal Eocene Periods. The first appearance of true horses in the Lower Eocene.

Monday, February 13.—"The Fossil History of the Horse," Continued.

Reasons for believing that the evolution of the true horses has taken place in this country. Causes of the extinction of all the native horses in North and South America.

Wednesday, February 15.—"Existing Races of Horses, Asses and Zebras."



Discussion of the question as to which of these types inhabited North America and the causes of their present distribution in Asia and Africa.

Monday, February 20.—"Probable Origin of the Domesticated Breeds of Horses."

Are domestic breeds of multiple origin? Semi-wild or feral race of horses in different parts of the world. Modes of distribution and intermingling of these breeds. The horse as a factor in civilization.

PEOPLE'S COURSE.

The programme of public lectures given Tuesday and Saturday evenings in co-operation with the Department of Education of the City of New York for the third course of the season 1904-1905 has been as follows:

Tuesdays, a course on European geography:

March 7.—MR. GERHARDT C. MARS, "Venice of the Golden Ring."

March 14.—PROF. H. E. NORTHROP, "Vesuvius and the Bay of Naples."

March 21.—DR. CLARENCE H. YOUNG, "Travels in Greece."

March 28.—MR. HENRY H. PARRY, "Wales and Her People."

April 4.—MR. PETER MACQUEEN, "Scotland."

April 11.—PROF. SUTTON FLETCHER, "Castles and Palace Homes of England."

April 18.—PROF. SUTTON FLETCHER, "The Cathedrals and Abbeys of Britain."

April 25.—MR. ROLAND S. DAWSON, "The St. Louis Expedition."

Saturdays, a course of lectures on sound and music by PROF. E. R. VAN NARDROFF:

March 4.—"Nature of Sound."

March 11.—"Musical Tone and Stringed Instruments."

March 18.—"Sympathetic Tone and Musical Timbre."

March 25.—"Simple Wind Instruments."

April 1.—"Reed Wind Instruments."

April 8.—"Miscellaneous Musical Instruments."

April 15.—"Sound Waves and Musical Harmony."

April 22.—"Telephone and Phonograph."

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home have been continued throughout the quarter. Papers on technical and general scientific subjects are read before these societies. The papers and discussions are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences holds its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Geology and Mineralogy.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

On Tuesday evenings on varying dates meetings are held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.

These meetings will continue throughout the month of May and then recess will be taken until October.

As illustrating the wide scope of the work of these societies and the general character of the papers presented at the meetings, we quote the following titles from the monthly bulletins of the Scientific Alliance of New York.

HOFRATH PROF. DR. ALBRECHT PENCK of the Imperial University, Vienna, on "The Glacial Surface Features of the Alps." Illustrated.

PROF. HENRY FAIRFIELD OSBORN on "Recent Discoveries of Extinct Animals in the Rocky Mountain Region and their Bearings on the Present Problems of Evolution." Illustrated.

PROF. J. J. STEVENSON on "Recent Advances in our Knowledge of the Composition of Coal."

PROF. JAMES F. KEMP on "New Sources of Supply of Iron Ore."

PROF. W. M. WHEELER on "Ants that Raise Mushrooms." Illustrated.

DR. F. A. LUCAS on "Whales and Whaling on the Coast of Newfoundland." Illustrated.

PROF. JAMES F. KEMP on "The Physiography of the Adirondacks." Illustrated.

PROF. F. E. LLOYD on "Botanical Research at the Desert Laboratory in Arizona." Illustrated.

MR. B. S. BOWDISH on "Photography in Nature Study." Illustrated.

MR. FRANK M. CHAPMAN on "Florida Bird Life." Illustrated.

MR. C. G. ABBOTT on "A Bird-lover in the Scottish Highlands."

MR. C. WILLIAM BEEBE on "A Naturalist's Camping Trip in Old Mexico."

MR. JONATHAN DEWIGHT, JR., on "Some of the Rare Birds of New York."

PROF. J. J. STEVENSON on "A Visit to the Coal Fields of the Island of Spitzbergen."

DR. GEORGE F. KUNZ on "The Jagersfontein Diamond, the Largest Diamond ever Cut." Illustrated with models and photographs.

DR. EDMUND OTIS HOVEY on "St. Vincent, British West Indies. The Eruptions of 1902 and their Immediate Results." Illustrated.

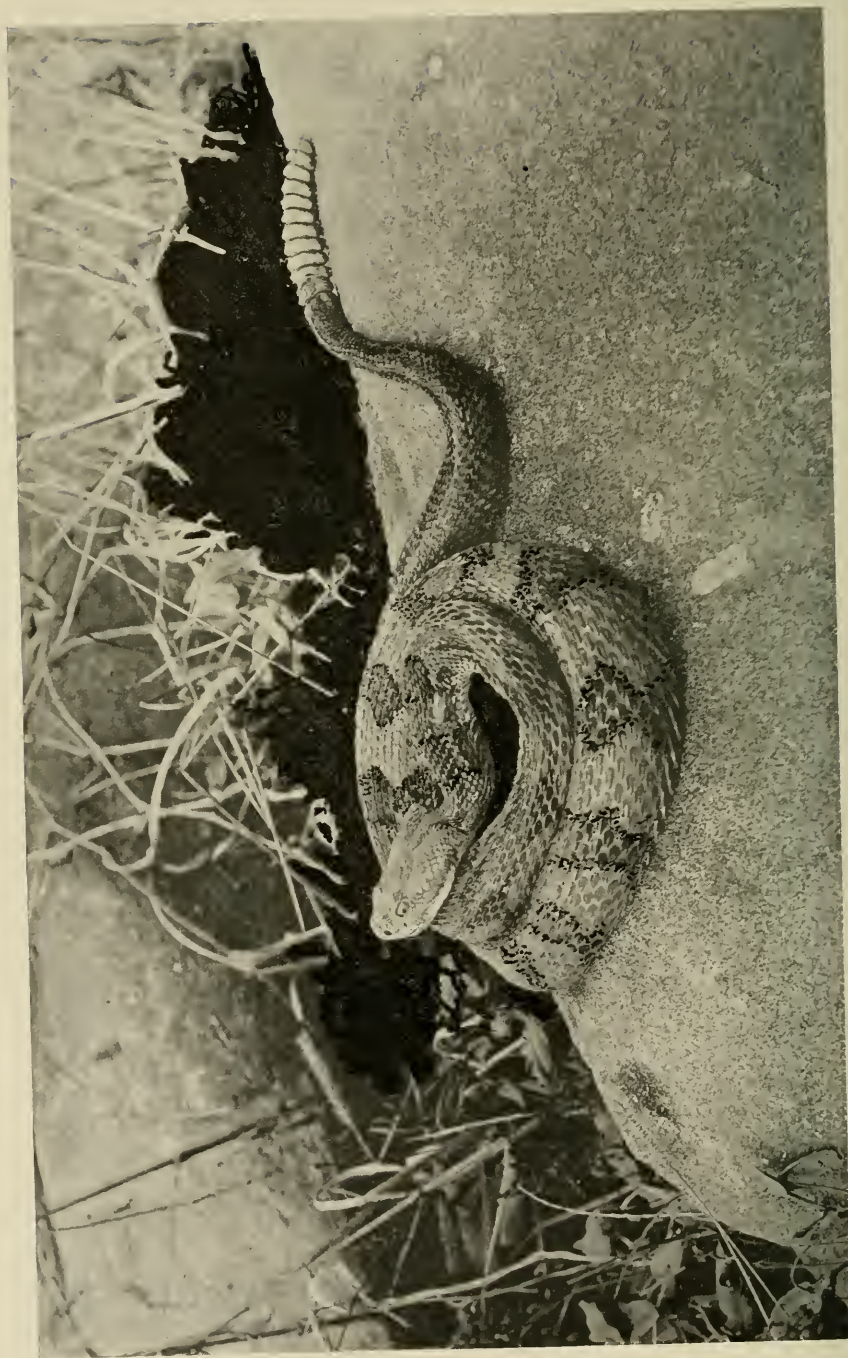


FIG. 1. BANDED RATTLESNAKE

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No. 3



THE principal article of the present number of the JOURNAL is upon the snakes, lizards and turtles which are to be found in the vicinity of New York City. This article will be published separately as No. 19 of the Museum series of Guide Leaflets, and will form a convenient summary hand-book for use in the field as well as in connection with the collections on exhibition in the Museum. The author of the leaflet is Mr. Raymond L. Ditmars, Curator of Reptiles in the New York Zoölogical Park in Bronx Park, who is well known to all students of nature through his careful study and interesting descriptions of the forms of animal life which are his special study. The excellent photographs forming the basis of the illustrations were taken from living specimens by Mr. Herbert Lang, of the Museum.

CORALS OF THE HAWAIIAN ISLANDS.

DURING the past summer Dr. J. E. Duerden, Honorary Curator of Coelenterates, carried out, under the auspices of the Carnegie Institution, an expedition to the Hawaiian Islands for the purpose of studying and collecting the living corals. The main object was to secure a representative series of Pacific corals from which comparison could be made with results already published upon West Indian forms. About three months were spent among the islands, the capital, Honolulu, being made the headquarters. The directors of the Rapid Transit Company there generously placed the facilities of their newly established aquarium at his disposal, the constant supply of fresh sea-water being of great assistance in keeping the corals alive for investigation day by day.

Between thirty and forty species of corals were collected,

besides numerous varieties of each species. These were studied in the living condition, and many specimens of each kind were preserved for later anatomical and histological investigation. More than fifty cases of dried corals, containing about 1,500 specimens, were obtained, forming probably the largest collection of Hawaiian corals ever made. These have been received at the Museum and will constitute an important series for studies on the variations of coral growth. A special feature of the collection is the large number of the mushroom coral, *Fungia*, showing all the stages of growth in both the fixed and free conditions.

While engaged in studying the specific characters of the corals, a series of experiments upon the physiology and reactions of the living polyps was carried out, a line of investigation upon which scarcely anything has hitherto been done. Important facts bearing upon the method of feeding of living corals were learned; particularly the part played by mucus, or slime. Particles of food placed on the disc of the polyps lead to an exudation of mucus, the opening of the oral aperture, and the establishment of an inhalent current by means of which the nutritive substances are ingested, after being imbedded in the mucus.

In addition to the collection of corals a representative series of Hawaiian actinians was also secured to supplement the "Albatross" collections made by the U. S. Bureau of Fisheries in 1902, upon a report of which Dr. Duerden is now engaged. Several specimens of crabs having the peculiar habit of carrying an actinian in each claw were also obtained, and observations and experiments made upon their habits and relationships. It is found to be a remarkable case of commensalism: the actinians serve to protect the crab, and in addition the crab actually makes use of the actinian in order to procure its prey, abstracting food from it. The crab in its turn has undergone certain structural modifications on account of the association.

THE Department of Invertebrate Palæontology has two parties in the field this season: one in charge of Mr. Walter Granger, searching for fossils in southwestern Wyoming, and the other under Mr. Barnum Brown exploring fields in Montana.

THE PUPILS' COURSE OF LECTURES.



THE second series of lectures to the public-school children, the programme of which was published in the April number of the JOURNAL, comprised thirty-four lectures upon twelve subjects. The records show that the total attendance at these lectures was more than 20,000 school children from Staten Island, Brooklyn and the upper Bronx, as well as from Manhattan. Although the usual number coming from each school was from forty to sixty pupils, some schools sent large delegations, notably P. S. 189, 99th St. and Second Ave., from which 200 to 400 pupils came to a lecture, and P. S. 177, Market and Monroe Sts., from which 200 to 300 pupils were brought. The lectures were not given during school hours, and attendance at them was in no wise compulsory, so that, inasmuch as the classes were accompanied by their teachers, the large numbers of pupils availing themselves of the opportunity to supplement their class work indicates not only the interest felt by the children in their studies, but also that of the teachers in their classes.

Although the lectures were primarily designed to supplement the classroom work, they undoubtedly have been the indirect cause of spreading much general information. Frequently teachers with their pupils have arrived early at the Museum and have spent an hour or more before the opening of the lecture in studying the collections, for instance: the bird groups and the series illustrating the protective coloration and mimicry of insects. On the way to the lecture hall children have caught glimpses of exhibits which have aroused their interest to such an extent that afterwards they have been seen at the Museum on Sundays or holidays accompanied by their parents.

THE Carnegie Institution has recently published a paper, "The Coral *Siderastraea radians* and its Postlarval Development," by Dr. J. E. Duerden, Honorary Curator of Coelenterates. The work is based upon observations carried on for four months while the author was Curator of the Museum of the Institute of Jamaica, and was completed at the American Museum.

THE CIRCULATING NATURAL HISTORY LOAN COLLECTIONS.



WING to the increase during the school year 1904-1905 in the demand for the small nature study collections which the Museum loans to the public schools it has been necessary to prepare additional sets. The following collections have been added to those in use last year: Owl, Blue Jay, Robin and Bluebird, ten each, duplicating the original bird collections, and ten collections, constituting a new series, each containing a Pigeon, a Goldfinch, a Hummingbird, a Vireo and a Scarlet Tanager. Twenty sets of a collection showing cross, longitudinal and oblique sections of ten species of our more common trees have also been prepared. The total number of collections available for nature study work at the present time is 235. They have been in use in 184 of the city schools, distributed among the Boroughs as follows: Manhattan, 139; Brooklyn, 28; Bronx, 13; Queens, 3; Richmond, 1.

Up to May 1, the collections have been studied by 255,845 pupils, as follows:

Birds	157,649
Insects	34,532
Woods	21,836
Minerals	12,185
Mollusks	9,452
Starfish	8,133
Corals	6,115
Crabs	5,943

The total number of pupils studying the different sets to the end of the school year will be about 325,000.

MUSEUM NEWS NOTES.

APPRECIATION of the work done by the Jesup North Pacific expedition in the study of the tribes of Eastern Siberia has been shown in special manner by the Czar of Russia, who has bestowed upon President Jesup the Knighthood of the Imperial and Royal Order of St. Stanislaus of the first degree. The or-

der of St. Stanislaus is one of the oldest and most distinguished of the Russian Empire.

MR. FRANK M. CHAPMAN represented the Museum at the Fourth International Ornithological Congress which was in session at the Imperial Institute, South Kensington, London, and other places in England, June 12 to 21. In addition to making careful studies of Museum methods at the British Museum and elsewhere in the United Kingdom, Mr. Chapman will study several features of the bird life of the British Isles before he returns.

DURING May Professor W. M. Wheeler and Dr. B. E. Dahlgren made an expedition to New Mexico, Arizona and California, for the purpose of studying the vegetation and invertebrate fauna of the desert. Through the kindness of Dr. F. V. Coville and Dr. W. A. Cannon they were able to work for a week at the Carnegie Desert Botanical Laboratory at Tucson, Arizona. Collections of specimens (including some ten thousand Formicidæ) were made at the following localities: Las Vegas and Albuquerque, New Mexico; Ash Fork, Prescott, Phoenix, Tempe, Tucson and Yucca, Arizona, and the Needles, California. A few days were also spent in and about the Grand Cañon of the Colorado. Professor Wheeler was able to complete his study of the North American desert Formicidæ, a study begun some years ago in Trans-Pecos, Texas. The nesting habits of several interesting species were observed for the first time and valuable photographs of nest architecture, characteristic desert environment, etc., secured. He also succeeded in gathering much information concerning the geographical distribution of the species and their dependence on soil, vegetation, amount of moisture, etc. A very interesting zonal distribution of species was observed on the walls of the Grand Cañon.

Dr. Dahlgren secured plants, soil, etc., needed for the accessories for several animal groups (antelope, peccary, prairie-dog and rattlesnake) now in process of preparation in the Museum.

At the request of the principals and teachers of several public schools, the Museum offered a course last spring in nature study

along the lines of their school work. The course consisted of six exercises—three on birds and three on insects—and embraced both laboratory and lecture work. The class met on Tuesday afternoons at four o'clock, during April and May, 35 being the average attendance. Owing to the absence on expeditions of Mr. Chapman and Professor Wheeler, arrangements were made with Mr. Jules M. Johnson, of the Morris High School, to conduct the course.

THE Department of Anthropology is participating in several expeditions in the Far West. Dr. P. E. Goddard, Instructor in Anthropology in the University of California, has gone among the Sarcee Indians of Canada. These Indians have been the means of the transmission of culture from the Plains Indians to the Athapascans of the woodlands and possess a mixed civilization. The object of the expedition is to secure facts regarding a definite case of mixed cultures and to collect specimens which, taken in relation to the collections from related types now in the Museum, will illustrate the extent and nature of such mixture. Mr. Frank G. Speck will visit Indian Territory and make ethnological collections. Mr. Edward Sapir is doing linguistic work among the Chinook of the Columbia River Valley and investigating the basketry decorations of the neighboring tribes. Dr. William Jones, Research Assistant in the Carnegie Institution of Washington, will visit the Algonquin Indians of the Great Lake region to continue his investigation of religious beliefs and practices. He will also strive to complete the collections in this Museum from that region. Miss Constance Goddard Du Bois will continue her studies of the music and mythology of the Indians of Southern California and make a special collection of basketry.

THE specimens of rocks and ores, nearly 400 in number, which were collected by Dr. E. O. Hovey on his recent expedition into the Sierra Madre region of western Chihuahua, Mexico, have been received at the Museum and catalogued. These and the 400 excellent photographs obtained of the wonderful country traversed are now open to the inspection of those interested in the region.

THE REPTILES OF THE VICINITY OF NEW YORK CITY.¹

BY RAYMOND L. DITMARS,

Curator of Reptiles, New York Zoölogical Park.

INTRODUCTION.

IN compiling this guide for the identification of the local reptiles, the writer has endeavored to present the subject in a simple and concise manner, avoiding technicalities as far as possible. The usual descriptions of reptiles concern arrangements of the scales upon the head and certain other physical characteristics that are necessarily associated with technical terms, but the keys for identifications and descriptions of the species in the present work appeal principally to the *coloration* and *form* of the reptiles. With but a limited number of species to consider, this plan seems appropriate, since it greatly simplifies the subject.

The reptiles described are those which have been found within a radius of about fifty miles of New York City. Within this section 28 species are represented. Of these species 14 are serpents, 2 are lizards and 12 are turtles. Thus our local fauna may be said to be quite rich in reptile life. In fact, it is within the limits of the area described that certain species of snakes (the Garter Snake, *Thamnophis sirtalis*, and the Brown Snake, *Storeria dekayi*) abound to such an extent that hundreds of specimens are annually killed and captured without apparent decrease in their numbers.

There are but two local species of poisonous snakes, the Banded Rattlesnake and the Copperhead. In certain districts both are fairly abundant, but may be hardly called a menace to mankind, as one is shy and retiring in habits, while the other

¹ Issued also in separate form as **Guide Leaflet** No. 19.

evinces an unmistakable characteristic of warning. There are but few records of the bites of venomous snakes in this portion of the United States.

SNAKES.

Order *Ophidia*.

The snakes are well represented in the Atlantic states, fourteen species being distributed through sections of the region surrounding New York City. Some of these reptiles attain fair dimensions, and several of the species are brilliantly colored. Two are venomous and of sufficient size to be formidable to man. These dangerous snakes, the Rattlesnake and the Copperhead Snake, may be recognized by their triangular heads which are quite distinct from the neck. The blunt tail of the Rattlesnake, terminating in its warning appendage, is a character hardly possible to be overlooked by the most indifferent observer. The Copperhead Snake is so strongly marked that identification is but the question of a moment's intelligent examination after an idea of the color pattern has been acquired.

Several of our harmless snakes have been provided with eccentric and misleading titles. To those unacquainted with reptiles, such species as the "Flat-headed Adder," the "Spotted Adder," the "Water Moccasin" and others of equally formidable appellation might be regarded as reptiles not entirely devoid of harm. Many of our harmless snakes which are of substantial economic importance in the destruction of the smaller injurious mammals possess the most evil reputation, although they really aid the agriculturist. The slaughter of these useful reptiles by the misinformed is a genuine calamity.

In the key to the identification of the local snakes, the attention of the student is especially directed to *color* and the *formation of scales*. Snakes are either provided with *smooth* or *keeled* scales, the latter having a distinct ridge, or keel, running lengthwise. The Garter Snake and the Water Snake are examples of snakes possessing *keeled* scales. This simple plan makes identification easy, and excludes the usual technical reference to the complicated arrangement of the scales or shields of the head, which requires technical knowledge for satisfactory

comprehension. To aid in this idea, the species are grouped in the key without regard to technical classification.

*Key to the Identification of the Local Snakes.*¹

a. SCALES SMOOTH.

Size small.

Light brown above; pinkish beneath;
snout conical. **Worm Snake** (*Carpho-*
phis amoenus).

Pale green above; white beneath. **Green Snake** (*Cyclo-*
phis vernalis).

Dark gray above; a yellow ring
around the neck; yellow beneath. **Ring-necked Snake**
(*Diodophis puncta-*
tus).

Size moderate.

Gray, with chestnut saddles above;
beneath white, with square spots of
black. **Milk Snake** (*Lampro-*
peltis doliatus trian-
gulus).

Size large.

Uniform satiny black above; black
beneath, with the chin and throat
white. **Black Snake** (*Bascan-*
ion constrictor).

aa. SCALES OF THE BACK FEEBLY KEELED.

Size large.

Black above; beneath white, blotched
with gray; scales of the sides show
white edges. **Pilot Blacksnake** (*Co-*
luber obsoletus).

b. SCALES KEELED.

Size small.

Brown above; pink beneath. **DeKay's Snake** (*Sto-*
reria dekayi).

Brown or gray above; bright red
beneath. **Storer's Snake** (*S. oc-*
cipito-maculata).

Dark brown or black above, with a
yellow stripe down the back and a
similar stripe on each side on third
and fourth rows of scales from
underside. **Ribbon Snake** (*Tham-*
nophis saurita).

¹ All of the local harmless snakes have eyes with round pupils. The two species of local poisonous snakes have elliptical (cat-like) pupils.

Size moderate.

Dark brown or black above, with a yellowish stripe down the back and a light stripe on each side on second and third rows of scales from under-side..... **Garter Snake** (*Thamnophis sirtalis*).

Dark brown or gray above, with reddish transverse bands; white or yellow beneath spotted with red... **Water Snake** (*Natrix fasciata sipedon*).

Dark yellow or brown, with darker transverse markings; snout upturned and sharp..... **Hog-nosed Snake** (*Heterodon platyrhinus*).

Head triangular, distinct from neck.

Light chestnut brown or pinkish-gray, with a series of dark brown transverse bands, narrow on the back and becoming wide on the sides..... **Copperhead Snake** (*Agkistrodon contortrix*).

Yellow, with dark transverse bands; sometimes dark tan or uniform black; tail ending in a rattle.... **Banded Rattlesnake** (*Crotalus horridus*)



FIG. 2. HEAD OF DIAMOND-BACKED RATTLESNAKE. SOUTHERN STATES

DESCRIPTIVE LIST OF THE SNAKES.

HARMLESS SPECIES.



FIG. 3. WORM SNAKE

The Worm Snake, *Carphophis amoenus* (Fig. 3), is a diminutive species which, though fairly abundant, is seldom seen, owing to its secretive habits. The Worm Snake is quite characteristic in appearance with its smooth, shining, cylindrical body and sharp snout; the head and neck are of the same width. In color this little serpent is quite somber and in harmony with the surroundings in which it lives. Above, it is light brown or brownish gray; beneath, the color is a delicate shade of pink. In length, the species seldom exceeds eleven inches.

**Worm
Snake.**

This reptile might possibly be confounded with the Storer's Snake and the DeKay's Snake, which small, retiring species it in a way resembles, principally in color and size, but it may be immediately recognized by its smooth scales; both of the other

species having keeled scales. The Worm Snake frequents damp localities and soft, loose ground, where it burrows with the aid of its sharp snout. Specimens are sometimes found in decaying logs. It is seldom found wandering about above the surface, except among damp leaves or after showers. The food consists largely of earthworms and soft grubs. This snake is oviparous.

Range: Central and eastern United States.

Local distribution: Long Island; Palisades of the Hudson.



FIG. 4. MILK SNAKE

The Milk Snake, *Lampropeltis dolius triangulus* (Figs. 4 and 5), is one of the most brightly colored of the local snakes.

Milk Snake. The body above is yellowish brown or gray, with a series of irregular chestnut-brown or reddish spots edged with black, about fifty in number; on the sides are smaller spots in alternation with those of the back. Beneath, the reptile is white, with numerous, small oblong spots of black. The length, when mature, is from three to four feet. The scales are smooth and polished.

Although this species is generally distributed, it is not of common occurrence. From a habit of sometimes frequenting the neighborhood of stables and dairies, it has acquired the reputation of obtaining milk from the cows. This is an illogical

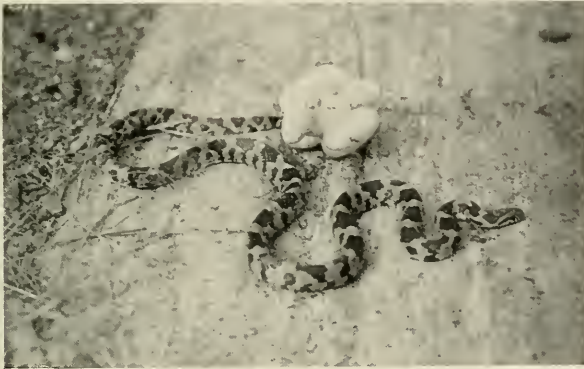


FIG. 5. MILK SNAKE ; WITH EGGS

theory, and proof of the actual deed from reputable observers is wanting. In captivity this serpent is wholly indifferent to milk, but will eat mice, young birds and small snakes other than its own species. It is a constrictor and closely related to the King Snake of the southern states. The Milk Snake is oviparous, laying eggs to the number of two dozen or more.

Range: The central and eastern United States; Canada.

Local distribution: General; frequents woods.

The Ring-Necked Snake, *Diadophis punctatus* (Fig. 6), is the most easily distinguished of the various local snakes. The scales of this little reptile are smooth and shining, while the body is a uniform dark gray or bluish black, with a brilliant yellow ring around the neck immediately behind the head. Beneath, the color is orange yellow; a single row of black spots is generally present. The length seldom exceeds fifteen inches.

Ring-
Necked
Snake.

These little snakes may be occasionally found in damp woods, under stones or burrowing under the bark of decaying trees. The species is quite rare within the limits under

consideration, but in some portions of the Hudson Highlands and in the Catskill Mountains it is rather abundant. In the southern states it is very common, the writer having taken several hundred specimens within a few days' time by stripping the bark from old, fallen trees. The Ring-necked Snake feeds largely upon earthworms and the smaller species of salamanders. It is oviparous.

Range: The United States east of the Rocky Mountains; Canada.



FIG. 6. RING-NECKED SNAKE

Local distribution: General.

Dainty and inoffensive both in looks and habits, the little Green Snake, *Cyclophis vernalis* (Fig. 7), may be easily known **Green** by its color which makes it quite distinct from other **SNAKE.** local species. The color above is a uniform pale green and beneath is light yellow or white. The scales are smooth and possess a satiny luster.

The Green Snake differs from the majority of serpents in being insectivorous. It feeds largely upon hairless caterpillars, although it also consumes crickets, grasshoppers and spiders. The usual length of the animal is about two feet. This species is oviparous.



FIG. 7. GREEN SNAKE



FIG. 8. BLACK SNAKE

Range: The United States east of the Rocky Mountains; Canada.

Local distribution: Common in Rockland, Dutchess and adjoining counties.

With the exception of one other species, the Black Snake, *Bascanion constrictor* (Fig. 8), attains the largest dimensions of any of the local serpents. Above and beneath, with the exception of the chin and throat, this reptile is a uniform black, the smooth scales imparting to the creature's back a luster similar to that of a gun-barrel. The chin and throat are milky white.

Young specimens show a remarkable variation from the adult snake. Like all the snakes described thus far, the Black Snake is an egg-laying species (oviparous). As is the case with the majority of the oviparous snakes, the eggs are left by the parent to be hatched by the heat of the sun or of decomposing vegetation. At the time of hatching, the young Black Snake belies its name. The body is pale gray with a series of brownish blotches down the back; the head and sides are irregularly spotted with black. At this stage it closely resembles the Milk Snake, but may be distinguished therefrom by the tendency of the blotches on the back to become very narrow as they approach the tail and to disappear almost altogether on that appendage. When a year old, the body color has become very dark, but close inspection will reveal the dorsal blotches. As age progresses the body color becomes darker until it assumes the intense black of the adult.

Extremely agile and feeding upon small rodents, birds, frogs and other snakes, the Black Snake is not a constrictor as its technical name implies, nor is it nearly so courageous as is generally supposed. When surprised, this reptile will invariably take to flight if this be possible, and few serpents can show the speed of this black meteor as it darts away, to stop only when apparent safety is attained. When cornered and escape is cut off, this snake will fight bravely, but the slightest opening is instantly taken advantage of by a dash for cover. The needle-like teeth can produce nothing but the most superficial wounds, yet this serpent is quite generally dreaded. Without doubt the

Black Snake is of value in the woods and fields, since its appetite craves the smaller mammals which are a menace to the agriculturist. The average length of adult specimens is between five and six feet.

Range: The entire United States and southern portions of Canada.¹

Local distribution: General, in rocky localities.



FIG. 9. PILOT BLACKSNAKE

The Pilot Blacksnake; Mountain Blacksnake, *Coluber obsoletus* (Fig. 9), attains the greatest length of any of the snakes embraced in the present list. This species is a powerful constrictor, and is the northern representative of the large and brilliantly-colored Rat Snakes of the South.

To the novice this serpent might appear similar to the preceding species. This similarity, however, applies only to color. Unlike the Black Snake or Racer, the scales are polished and the body presents a metallic, shining appearance instead of a satiny luster.

¹ The typical (black) form inhabits the Eastern States; a variety of lighter color frequents the Middle States; in the Western States is the variety called the Green Racer (*B. constrictor flaviventris*).

The general color above is black, the scales of the sides showing white edges when the body is distended. Beneath, the color is white, blotched with gray on the forward portion; posteriorly the gray becomes suffused over the entire surface; the chin and throat are white and immaculate. Close examination will reveal the scales of the back to be faintly keeled, which characteristic at once separates the species from the Black Snake. The head is broad and rather flat; the under surface of the body is so abruptly flattened as to form right angles with the sides.

This species is built rather for climbing than for speed, and generally frequents low bushes, where it lies in wait for birds and small mammals. The species attains a length of more than six feet. It is oviparous.

Range: Eastern United States from Maine to Florida; the Central States; in the South the species extends westward to Texas.

Local distribution: Highlands of the Hudson; not common.

The Hog-nosed Snake, *Heterodon platyrhinus* (Figs. 10 and 11), may be recognized by its sharp, upturned snout, which shovel-like appendage is employed to assist the reptile in burrowing in the sandy soil in which it lives. The markings of this peculiar snake are extremely variable, but the color is generally yellowish brown, with dark brown or black irregular cross-bands. Some specimens show brilliant shades of yellow and red; others are entirely black. The latter constitute the variety *niger*.

The species is stout in body, and the scales are keeled. When annoyed, it assumes a threatening attitude by flattening the head and neck and hissing loudly. In spite of its hostile demeanor, it seldom attempts to bite, but contents itself by endeavoring to frighten the object of its annoyance by its eccentric antics. In different localities the species has been given appellations that have placed this harmless reptile in bad repute. Such names as "Flat-headed Adder," "Blowing Viper" and "Spreading Adder" are energetically used by the farmer who usually refuses to be convinced that this snake is not akin in poisonous faculties to the Copperhead, to which it bears some resemblance in proportions and markings.



FIG. 10. HOG-NOSED SNAKE



FIG. 11. HOG-NOSED SNAKE (VAR. NIGER)

When repeatedly annoyed, this snake will feign death and may then be roughly handled without its displaying signs of life. Its food consists principally of toads. The species is oviparous, depositing about two dozen eggs. A large specimen will measure three feet in length and one and a half inches in diameter.

Range: The United States east of the Rocky Mountains.

Local distribution: Found in nearly all the sandy localities adjacent to New York City. Common on Long Island and the Bayonne peninsula, New Jersey.



FIG. 12. RIBBON SNAKE

The Ribbon Snake, *Thamnophis saurita* (Fig. 12), is a species which might be easily confounded with the Garter Snake, owing to the similarity of markings. The body color is dark brown or black, with a bright and very clearly-defined stripe of yellow down the back and a similar stripe on each side. The body is very slender and the scales are distinctly keeled. When the skin is distended the sides of the body show small, white spots.

The chief differences between this species and the Garter

Snake are the following: 1. The stripes on the sides are situated on the third and fourth rows of scales from the plates of the crawling surface; with the Garter Snake the lateral stripe is situated on the second and third rows of scales. 2. The underside is immaculate, while the abdomen of the Garter Snake shows a row of small black spots on each side. 3. The Ribbon Snake is, in proportion, considerably more slender than the other species.

The active little Ribbon Snake frequents damp meadows and woods. It seldom exceeds three feet in length. Its food consists

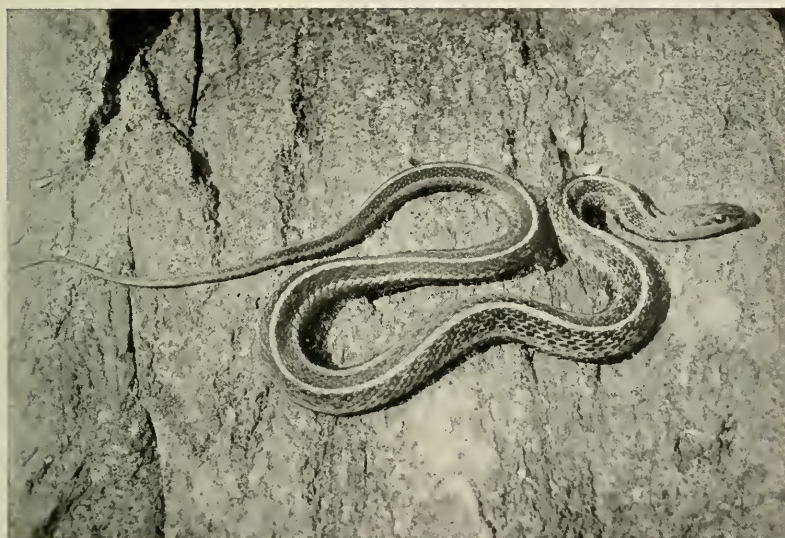


FIG. 13. GARTER SNAKE

of small fishes, tadpoles and frogs. The species is viviparous, but the number of young is small, seldom amounting to a dozen.

Range: Southeastern Canada and the United States east of the Rocky Mountains.

Local distribution: General, but not common.

The Garter Snake, *Thamnophis sirtalis* (Fig. 13), is the most common of our local serpents. The general color above is dark-brown or black, with three yellowish stripes running lengthwise; beneath, the color is greenish yellow.

Garter
Snake.

The skin along the sides when distended shows numerous white

or greenish spots. The scales are strongly keeled. The species varies in color; specimens are occasionally found upon which the stripe on the back is indistinct or entirely wanting; others present a spotted appearance between the stripes.

Abundant under various conditions of swamp, woods and rocky localities, the Garter Snake will continue to exist within our local borders long after many of the other species of serpents have been exterminated by the ruthless slaughter that unjust prejudice inspires. The species is viviparous, bringing forth as many as thirty or more living young at a brood. The young reptiles feed upon earthworms and grow rapidly. While immature, these snakes are secretive, and the character of their food enables them to obtain a livelihood without prowling forth into danger. Far different is the case of the active young Blacksnake in search of mice, as it crosses roads and clearings into the danger zone of stones and clubs.

The adult Garter Snake feeds mostly upon frogs and toads; birds and small mammals are never devoured by this species. The length of a large specimen is about a yard.

Range: North America, southward to Guatemala.

Local distribution: General and common; is found in the large parks of New York City.

Our common Water Snake, *Natrix fasciata sipedon* (Fig. 14), is a variety of a species abundant in the southern states. The **Water Snake.** body is rather stout, with strongly keeled scales; the color is brown with broad irregular cross-bands of reddish brown which show more distinctly on the sides. The underside is yellowish white, brightly marked with red spots and blotches. The young of this species are quite different from the adult in coloration, the body color being gray with the cross-bands black and very distinct. The adult attains a length of four feet and a diameter of two inches. From two and a half to three feet long, however, is the usual size.

Always frequenting the vicinity of water, this snake may be seen in numbers along slow-running streams, either sunning itself on the banks or stretched upon the branches of bushes that overhang the water. It feeds upon fishes, frogs and toads. The Water Snake is viviparous, bringing forth as many as forty

or more young at a litter. The young are born during the latter part of August and early in September.

Range: The eastern United States from Maine to North Carolina.

Local distribution: Common near ponds, streams and salt-water marshes.



FIG. 14. WATER SNAKE

Among the local snakes, DeKay's Snake, or Brown Snake, *Storeria dekayi* (Fig. 15), is unique in surviving in localities where the other serpents have long since been ex-terminated. It is common in many portions of the large city parks, where its secretive habits, diminutive size and quiet colors aid in its protection.

**Brown
Snake.**

In color this reptile is brown or brownish gray above, with a minute series of black spots in pairs usually present down the back; the space between these spots is sometimes of a lighter tint than the body color, producing the appearance of an indistinct stripe in some specimens; beneath, the color is pinkish white. The scales are keeled. The average length of adult specimens is twelve inches.

This snake is most frequently found hiding under flat stones, and in such places the reptile searches for its favorite food, which consists of earthworms.

The Brown Snake is viviparous, producing from fifteen to eighteen young during August. During the first year the young snakes are very dark with a whitish ring around the neck. At this stage they resemble the young of the Ring-Necked Snake,



FIG. 15. DEKAY'S, OR BROWN SNAKE

but they may be distinguished therefrom by their keeled scales. When adult, the average length of the Brown Snake is about fourteen inches.

Range: Canada and the eastern United States from the Atlantic coast westward to Kansas and southward to Mexico.

Local distribution: Common in rocky localities.

The Storer's Snake, or Red-Bellied Snake, *Storeria occipitomaculata* (Fig. 16), closely resembles the Brown Snake, but may

be distinguished therefrom by its bright vermilion underside. Down the back of Storer's Snake there is

usually a well-defined stripe of a lighter shade than the body color, which is brown or dark gray; occasionally specimens are slaty gray with a light stripe down the back bordered with rows of minute black spots. On such specimens the bright red of the underside is especially intense. It is a smaller species

than the preceding, seldom attaining a length of more than eleven inches. The young are produced alive, and are black with a whitish ring around the neck.

Range: The same as the preceding species, but may extend farther north in Canada.



FIG. 16. STORER'S, OR RED-BELLIED SNAKE

Local distribution: Not found within the immediate vicinity of New York City, but is common northward; occurs abundantly in Orange, Rockland and Putnam Counties.

POISONOUS SPECIES.

The Copperhead Snake, *Ancistrodon contortrix* (Fig. 17), is a strongly marked species and easily determined. The body color is light chestnut brown, sometimes assuming a Copper-tinge of pink, crossed with dark, reddish-brown bands, head Snake. which are narrow on the back and wide on the sides, resembling from above the outlines of a dumb-bell; these bands are darkest at their edges, particularly on the sides of the body. The head is somewhat lighter than the body, usually exhibiting a coppery tinge or a bright hazel brown; the sides of the head are of a still

paler hue. The line of intersection of the lighter color with the coppery tints of the top begins behind the eye and runs to the angle of the mouth. Beneath, the body is pinkish white, with two rows of reddish-brown blotches; the scales are keeled; the pupil of the eye is elliptical.¹

Although the head of this serpent is triangular and distinct from the neck, the general appearance of the reptile would not immediately lead the uninitiated to class it as a poisonous snake. Several of our local serpents are quite as heavy in body as the

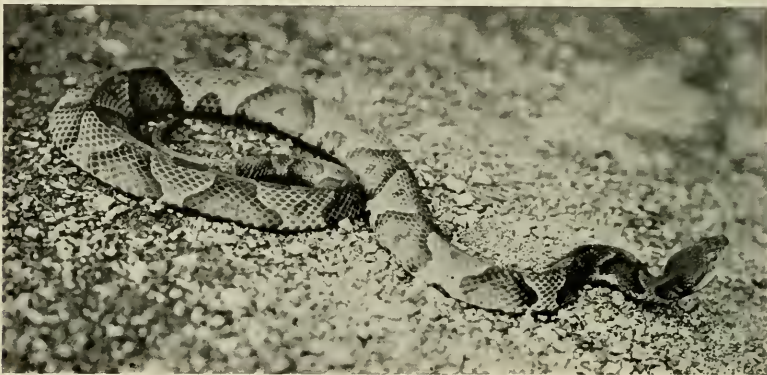


FIG. 17. COPPERHEAD SNAKE

formidable Copperhead. The Milk Snake, the Hog-nosed Snake and the Water Snake are sometimes confounded with the Copperhead, partly on account of a similarity of pattern, and partly on account of the stout bodies of the last two species. From the Milk Snake the Copperhead may be at once distinguished by its keeled scales; from the Hog-nosed Snake and the Water Snake by the arrangement of the plates under the tail.² Beginning from the vent, these broad plates in the harmless reptiles are in two rows; in the Copperhead they are arranged in one row, extending across the underside of the tail like the plates of the belly, with the exception (in some specimens) of a few scattered, divided plates near the tip of the tail. From all the harmless snakes the Copperhead may be distinguished by the presence of a

¹ The eyes of all of our harmless snakes have round pupils.

² The sub-caudal plates of all the harmless snakes are in two rows.

pit between the eye and the nostril, a characteristic of the crotaline snakes that has led to their popular title, "the Pit Vipers."

The upper jaw of the Copperhead is provided with two long fangs which fold against the roof of the mouth when the latter is closed. These teeth are hollow and are provided with an opening at the tip for the ejection of poison. They are precisely the same in their formation as the needle of a hypodermic syringe. The poison is secreted in glands behind the reptile's eyes, and is forced through the fangs by muscular contraction during the act of biting.

The Copperhead is the most beautiful of our local snakes, its delicate colors so closely resembling the falling leaves of autumn that it is with difficulty to be distinguished from its surroundings at that time of the year. When annoyed, it imparts a rapid, vibratory movement to the tail, which when among dried leaves produces a distinct rattling, audible for several feet. Its bite is very dangerous, but the snake is not habitually hostile and it prefers flight to combat. When cornered, however, it will fight bravely, striking from a partly coiled position. The food of this snake consists of small mammals, birds and frogs. From six to nine young are produced alive during August or early in September. The tails of the young snakes are bright sulphur-yellow, which tint gradually fades as the reptile matures. A large adult specimen will measure three feet in length.

Range: Massachusetts to Florida, westward to Texas.

Local distribution: Palisades of the Hudson River, northern Westchester, Rockland, Putnam and Orange Counties, N. Y. Prefers thick, damp woods and in some districts (Orange and Rockland Counties) is moderately abundant.

With the rattle as an unvarying characteristic, the dangerous Banded Rattlesnake, *Crotalus horridus* (Figs. 1 and 18), may be instantly recognized. Female specimens are generally sulphur-yellow or brown, with black, or dark-
brown transverse bands; the males are usually very
dark brown or black with little trace of the bands, except yellow
markings that show the location of the borders of the transverse
blotches. The scales are roughly keeled. The head is triangular
and covered with small, irregular scales.

**Banded
Rattle-
snake.**

The young are produced during the latter part of August to the number of about a dozen. They grow rapidly and acquire, on an average, three joints of the rattle every year; the young snakes are born with a single "button" on the tail. The average length of a mature snake of this species is from three and a half to four feet.

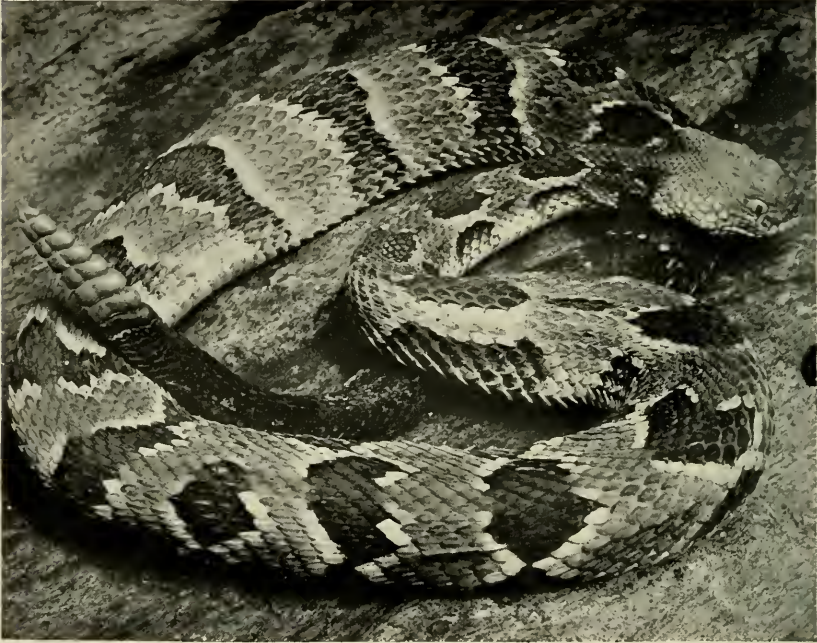


FIG. 18. BANDED RATTLESNAKE

Subsisting upon larger prey, such as squirrels, rats, young rabbits and birds, the Rattlesnake is a bolder reptile than the Copperhead. Provided with proportionately longer fangs and a more virulent poison, the bite of this species is more dangerous than the former. It generally frequents rocky localities and has a wide range of distribution.

Range: Massachusetts to northern Florida, and westward to Texas.

Local distribution: Within fifty miles of New York City, the Rattlesnake is now very scarce. Occasional specimens are reported from Putnam County.

LIZARDS.

Order *Lacertilia*.

The local Lizards, which number two species, are so different in general aspect that immediate identification is possible even to the novice. The smooth, shining Blue-tailed Lizard and the rough, somber-tinted Fence Swift are the examples. The occurrence of the latter species is rare within the limits embraced by this list. Both species are very active, and are insectivorous in habits.

Key to the Identification of the Local Lizards.

a. BODY SMOOTH AND SHINING:

Two phases—

aa. Body black, with five yellow stripes; tail blue.....*Young*.

ab. Body brown; stripes indistinct or wanting; head reddish.....*Mature*.

aa and ab.....**Blue-tailed Lizard**
(*Eumeces quinquelineatus*).

b. BODY ROUGH; THE SCALES KEELED:

Gray or brown with lighter blotches..

Fence Swift (*Sceloporus undulatus*).

DESCRIPTIVE LIST OF THE LIZARDS.

The Blue-tailed Lizard, *Eumeces quinquelineatus* (Fig. 19), is an active species, generally distributed. It may be readily recognized by its smooth, shining scales and bright colors. There are two phases of coloring, one representing young individuals and the other the fully matured animals. Young specimens are black, with five bright

**Blue-tailed
Lizard.**

yellow stripes running lengthwise on the body; the tail of such specimens is usually a brilliant blue,—hence the name. Upon approaching maturity the body assumes a brownish tinge, the stripes become less distinct, and upon the males disappear altogether, while the head takes on a tinge of red. The females retain the stripes, although they are less distinct against the brown body-color than in young specimens; the head of the female is much narrower than the male, while the red tinge upon the same is never so brilliant as in the other sex. The complete color transformation takes about four years.



FIG. 19. BLUE-TAILED LIZARD, YOUNG AND ADULT

The female of this species deposits her eggs, to the number of about a dozen, under the bark of a decaying tree, and coils about the edge of the cluster in serpentine fashion until they hatch. Large specimens of the red-headed form measure eight inches in length. In the South the species grows much larger and is very abundant. The adult males are called "Scorpions."

Range: Southern Massachusetts to Florida; westward to Texas.

Local distribution: General in sunny openings of woods, but not common.

The Fence Swift, *Sceloporus undulatus* (Fig. 20), common everywhere in the southern United States, is very rare within a radius of fifty miles of New York City. In the pine forests of southern New Jersey this agile creature is particularly abundant, and may be seen darting with bewildering speed along fences and fallen trees.

Fence
Swift.



FIG. 20. FENCE SWIFT

Unlike the Blue-tailed Lizard, so conspicuous on account of its shining scales, the Fence Swift presents a rough, lusterless surface. The scales are keeled and terminate in sharp, spine-like fashion. The body is rather broad, the head wide. In color this lizard is gray or brown with a series of V-shaped blotches on each side of the body; the underside is dark-gray or black with several large patches of blue. The latter patches vary in intensity according to conditions of temperature and the

activity of the reptile. Six inches is the average length of fully mature specimens.

Range: New Jersey to Florida.

Local distribution: Recorded from the Palisades of the Hudson River and Monmouth County, N. J.

TURTLES.

Order *Chelonia*.

Of the twelve species of turtles, or chelonians, found locally, three are marine wanderers from warmer climes and of rare occurrence. The marine turtles may be immediately recognized by their peculiar paddle-like limbs which are frequently termed "flippers." The use of these members in the progress of a sea turtle through the water has been appropriately compared to the flight of a hawk or an eagle. Of the other species of chelonians, one is strictly terrestrial in habits, while eight species are semi-aquatic and frequent the neighborhood of ponds and marshes.

The upper shell of a turtle is technically known as the "carapace," the lower shell as the "plastron." These terms have been employed throughout the description of the species with a view of abbreviation.

Key to the Local Turtles.

- a. LIMBS LONG AND PADDLE-LIKE (FLIPPERS) **SEA TURTLES.**
 - aa. Carapace with seven heavy keels, running lengthwise.
 - Uniform dark brown. **Leather - back Turtle**
(*Dermochelys coriacea*).
 - ab. Carapace smooth.
 - Olive - brown; head very large; usually two nails on each flipper. **Loggerhead Turtle**
(*Thalassochelys caretta*).
 - Olive or brown, marbled with yellow; head of moderate size; usually one nail on each flipper. **Green Turtle** (*Chelonia mydas*).

b. LIMBS AND FEET WELL DEVELOPED; FEET
WEBBED.....**POND AND MARSH
TURTLES.**

ba. Carapace smooth.

1. Plastron hinged to close against
the carapace.

Dark brown; a yellow stripe
on each side of the head...**Musk Turtle** (*Aromochelys odoratus*).

Dark brown; head speckled.**Mud Turtle** (*Kinosternon pennsylvanicum*).

2. Plastron rigid.

Black or olive above; lower
edge of carapace brightly
marked with red; plastron
yellow.....**Painted Turtle** (*Chrysemys picta*).

Carapace black with numer-
ous yellow spots; plastron
black, blotched with yel-
low.....**Spotted Turtle** (*Chelopus guttatus*).

Carapace black or brown, the
shields showing lighter
borders; head black; a
brilliant yellow patch on
each side behind the eye..**Muhlenberg's Turtle**
(*Chelopus muhlenbergii*).

bb. Carapace showing raised, angular
lobes.

Plates of carapace concen-
trically ringed; light brown
above, limbs, neck and
fleshy parts salmon red...**Wood Turtle** (*Chelopus insculptus*).

Plates of carapace with nu-
merous concentric rings;
color, olive above, head

and limbs gray, profusely
spotted with black.....**Diamond-Back Terra-**
pin (*Malacoclemmys*
palustris).

Tail long, partly covered
with plates; head very
large; color brown or
olive.....**Snapping Turtle** (*Che-*
lydra serpentina).

♂. FEET CLUB-SHAPED, NOT WEBBED.....**TORTOISES.**

Carapace high; plastron
hinged; color brown, ir-
regularly marked with yel-
low.....**Box Tortoise** (*Cistudo*
carolina).



FIG. 21. HEAD OF LEATHER-BACK TURTLE

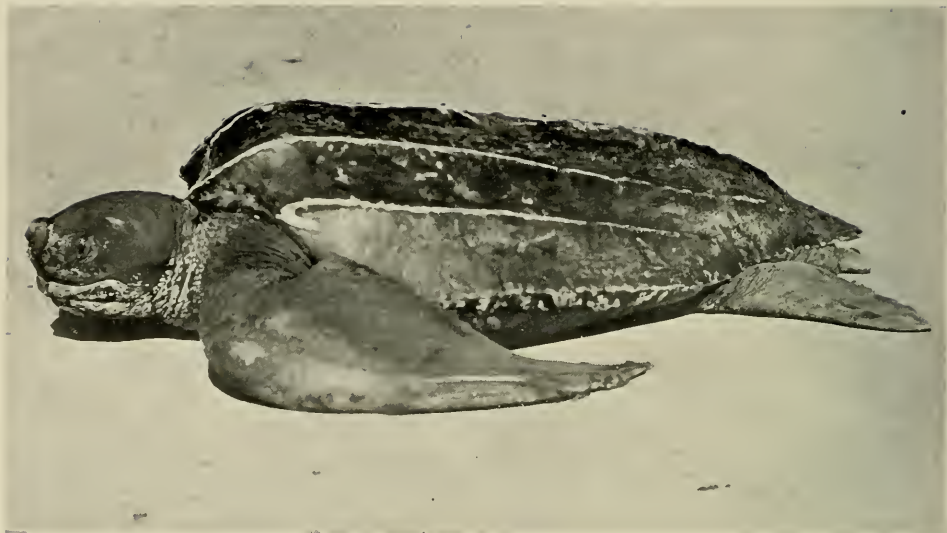


FIG. 22. LEATHER-BACK TURTLE



FIG. 23. LEATHER-BACK TURTLE; ON ITS BACK

DESCRIPTIVE LIST OF THE TURTLES.

The Leather-back Turtle, or Trunk Turtle, *Dermochelys coriacea* (Figs. 21, 22 and 23), is easily distinguished from the two other species of sea turtles occasionally taken off our coasts, by the heavy, ridge-like processes, seven in number, running lengthwise on the carapace. Instead of the horny plates usually present on turtles, the carapace and plastron of this species are covered with a leathery integument. The Leather-back Turtle attains a large size. In warmer waters specimens are occasionally captured which exceed seven feet in length. The general color is dark brown, although there is sometimes a sprinkling of yellow. Like the other sea turtles this species never comes to the shore, except for the purpose of depositing eggs. Its flesh is of no value for food purposes. The reptile feeds upon fishes, crustacea, mollusks and seaweeds.

Range: Tropical seas.

Local distribution: Occasionally off the Atlantic coast of the Middle Atlantic and New England States, where its presence is accidental.

The Loggerhead Turtle, *Thalassochelys caretta* (Figs. 24 and 25), might possibly be confounded with the Green Turtle, owing to a similarity of the shells of these species. Certain characters, however, make determination comparatively simple. The head of the Loggerhead is very large in proportion to the reptile's size; the flippers are generally provided with two nails, while the shell is dark brown, sometimes marked with a lighter brown. The colors of the Green Turtle are much lighter; the head of medium size; there is generally one nail on each flipper. Both of these species have shells covered with smooth shields. The flesh of the Loggerhead is little cared for. It does not deposit eggs in temperate regions. This species attains a length of six feet.

Range: Tropical and semi-tropical seas.

Local distribution: An accidental visitor off the Atlantic coast.

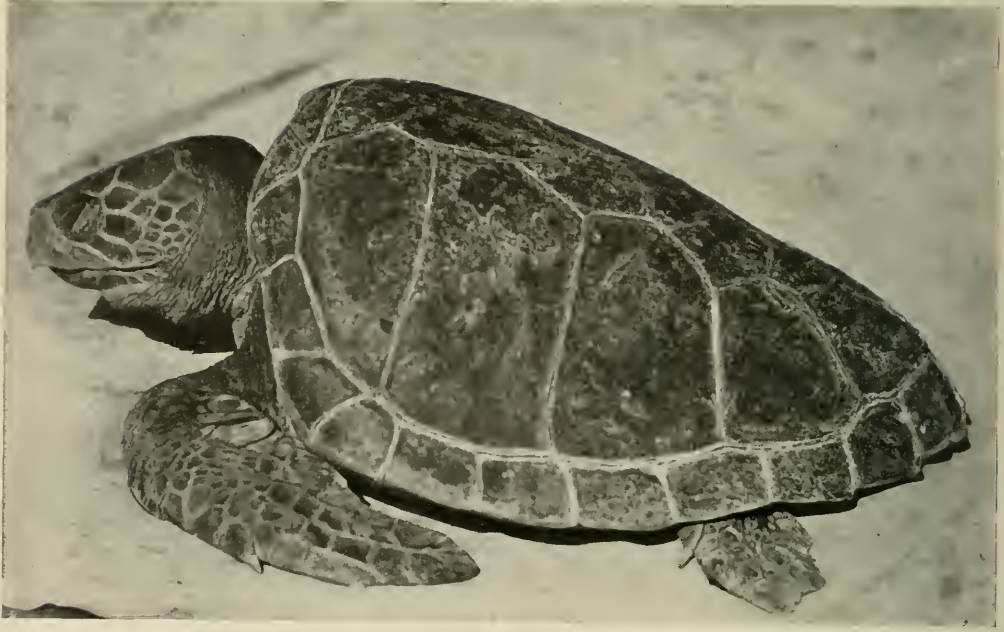


FIG. 24. LOGGERHEAD TURTLE

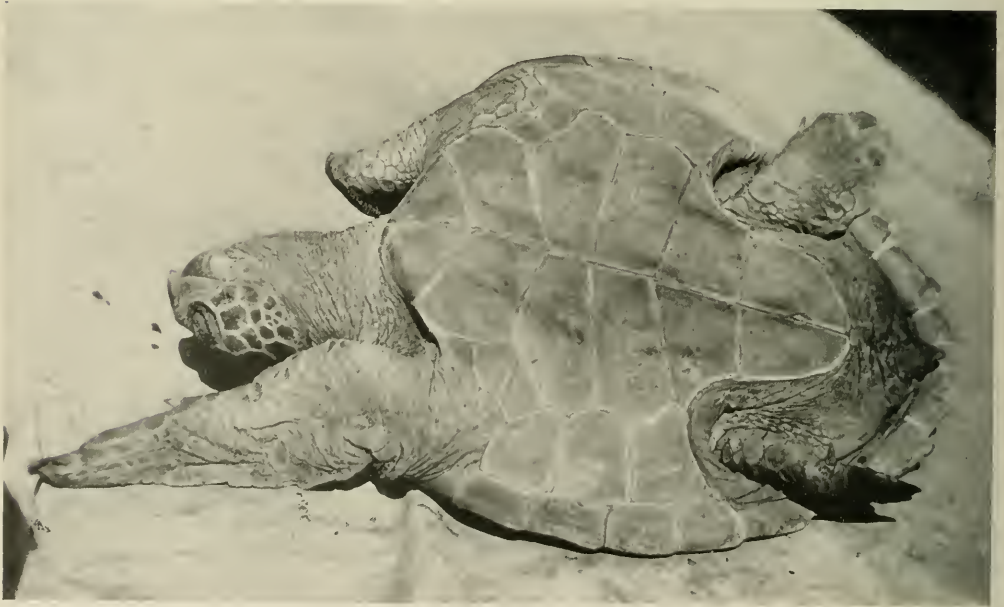


FIG. 25. LOGGERHEAD TURTLE ; ON ITS BACK



FIG. 26. GREEN TURTLE

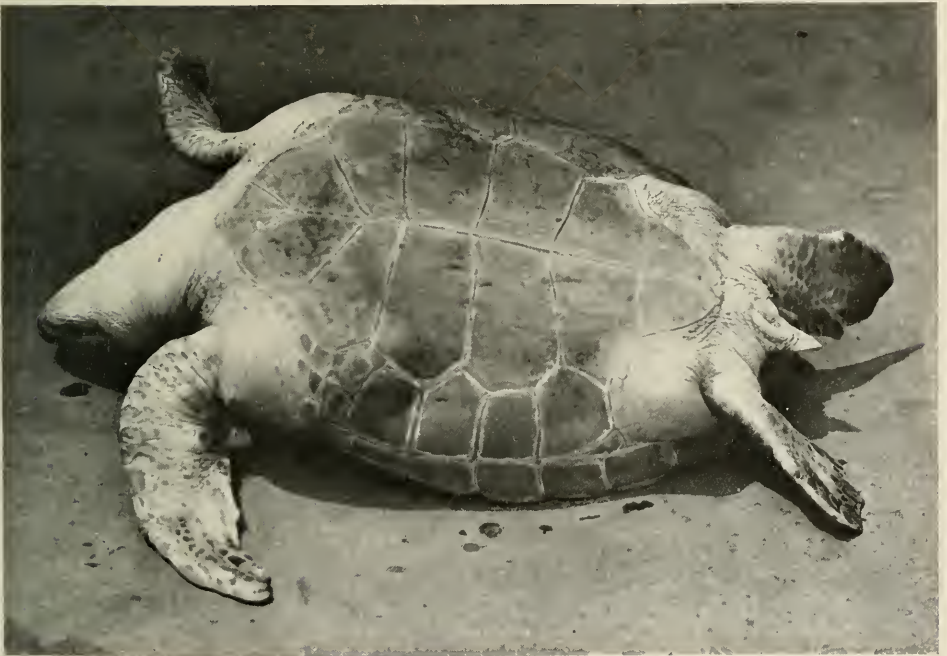


FIG. 27. GREEN TURTLE; ON ITS BACK

The Green Turtle, *Chelonia mydas* (Figs. 26, 27 and 28), is an attractive species, the coloration of the shell being a pale olive, marbled with yellow. The Green Turtle obtains its name from the distinctly green hue of its fat. Highly esteemed as an article of food, these turtles are commonly seen in the markets lying upon their backs, in which position they are helpless.¹ In tropical waters this species is alleged to attain a weight of a thousand pounds.

Green
Turtle.

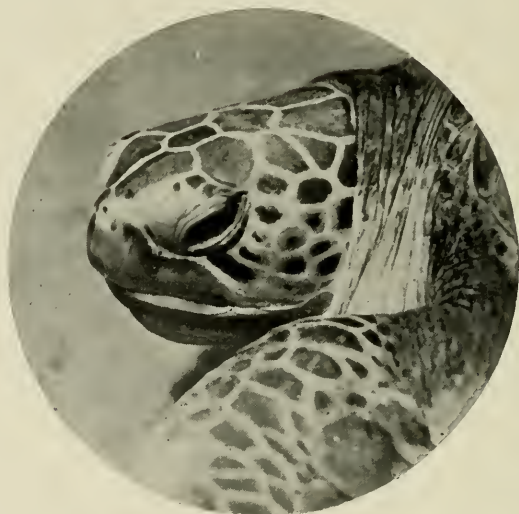


FIG. 28. GREEN TURTLE; HEAD

Range: Tropical and semi-tropical seas.

Local distribution: An accidental visitor off our northern seacoasts.

The Snapping Turtle, *Chelydra serpentina* (Figs. 29 and 30), represents the largest species of our local turtles, excepting the three already described. Its rough carapace of somber brown, with its keels and serrations, and the proportionately huge, sinister head combine to make this creature unique among our turtles. The tail is long and possesses a series of plates which form an alligator-like crest; the carapace is deeply serrated posteriorly. In proportion to

Snapping
Turtle.

¹ The majority of the fresh-water turtles, however, when so placed, can readily roll over through the combined assistance of the head and limbs.



FIG. 29. SNAPPING TURTLE

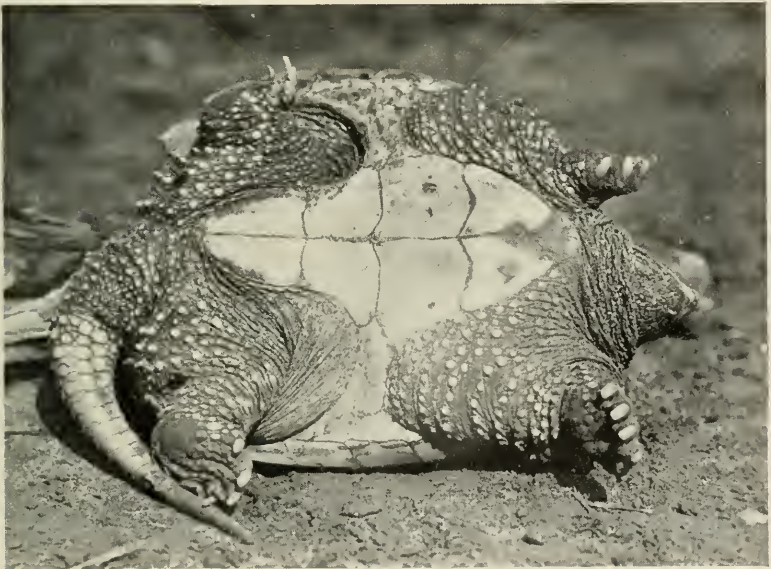


FIG. 30. SNAPPING TURTLE ; ON ITS BACK

the reptile's size the plastron is very small and provides little or no protection for the limbs in time of danger. In color the Snapping Turtle is dark brown, with no markings. Adult specimens attain a length of two feet and a weight of from thirty-five to forty pounds. The carapace of old specimens is often covered with moss.

Slow-running muddy streams and large ponds are the lurking places of these reptiles, which are exceedingly voracious. Lying partly hidden in the mud, they await the approach of fish or even young water fowl. Possessed of a pugnacious disposition, a large specimen might well be rated as dangerous. The hooked jaws are capable of inflicting deep wounds, and are, moreover, employed with energy when the reptile is annoyed. When of medium size, the species is said to be edible. The eggs are deposited in June, to the number of from two to four dozen; they are perfectly spherical and possess a hard shell.

Range: Canada and the United States east of the Rocky Mountains; southward to Ecuador.

Local distribution: General and abundant.

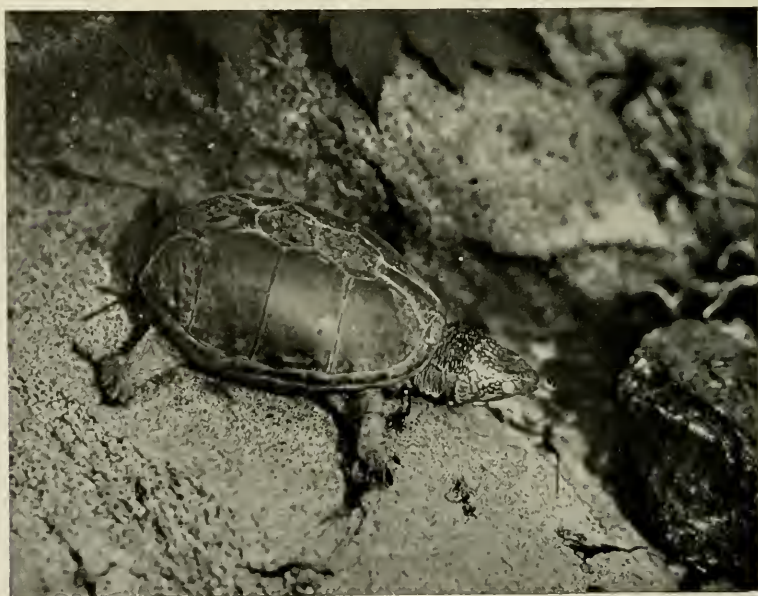


FIG. 31. MUD TURTLE

The Mud Turtle, *Kinosternon pennsylvanicum* (Figs. 31 and 32), is often confounded with the Musk Turtle (*Aromochelys odoratus*), which it resembles in shape and size. The principal differences between the two species are in the markings of the head and the width of the plastron.

Mud
Turtle.

The head of the Musk Turtle shows on each side two distinct, yellowish stripes, beginning at the tip of the snout and running to the neck, and the plastron is very narrow and is much shorter than the carapace, affording little protection. The Mud Turtle, on the other hand, shows no stripes upon the head and neck; the head is irregularly speckled with green or yellow; the plastron is wide, is but a trifle shorter than the carapace, and can be closed to afford substantial protection. The average length of the Mud Turtle in this vicinity is about three and one-half inches when adult. It is not as common as the Musk Turtle.

Range: The eastern United States from New York to the Gulf of Mexico.

Local distribution: General in slow-running, muddy streams and ponds.

The Musk Turtle, *Aromochelys odoratus* (Figs. 33, 34 and 35), may be distinguished from the Mud Turtle, which it closely resembles, by the points given under the preceding caption.



FIG. 32. MUD TURTLE; ON ITS BACK



FIG. 33. MUSK TURTLE



FIG. 34. MUSK TURTLE

In some localities the Musk Turtle is very common, particularly in slow-running rivers with soft, muddy beds. When annoyed, it gives off a musky odor which is strong enough to be offensive. The carapace of an old specimen is usually so overgrown with moss as to be seen with difficulty when the animal is lying in the mud in shallow water, as is its habit. This species is frequently hooked in freshwater fishing. In many ways the species resembles, in miniature, the Snapping Turtle. From three to four inches is the maximum size.

Musk
Turtle.



FIG. 35. MUSK TURTLE; ON ITS BACK

Range: Eastern North America from Canada to the Gulf of Mexico.

Local distribution: General in slow-running streams and ponds. Occurs within the limits of New York City, and is very common in the Bronx River.

None among our turtles is better known, although possibly only by name, than the Diamond-back Turtle, or Terrapin, *Malacoclemmys palustris* (Figs. 36 and 37). The shields of the carapace rise from the surface of the shell in a series of rough, concentric rings; the row of shields down the back shows a broken keel which rises rather sharply in the center of each plate: this condition is especially

Diamond-
back
Terrapin.



FIG. 36. DIAMOND-BACK TURTLE (TERRAPIN)



FIG. 37. DIAMOND-BACK TURTLE; ON ITS BACK



FIG. 38. PAINTED TURTLE

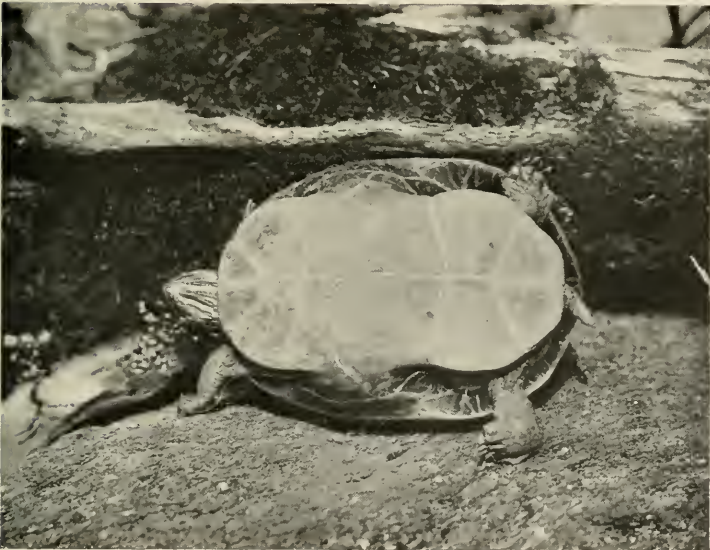


FIG. 39. PAINTED TURTLE ; ON ITS BACK

prominent in young specimens and decreases with age and consequent wear of the shell. The color of the carapace is uniform green or olive, although the edges of the plates are sometimes of a slightly different shade. The general color of the limbs, head, neck and tail is pale gray, profusely spotted with black; the plastron is yellow, lined and spotted with gray.

The Diamond-back is the familiar market terrapin, and at certain times of the year sells as high as \$70 per dozen. It is becoming rare in the north. Large specimens will measure ten inches in length. This is the only species of local turtle (with the exception of the Sea Turtles) that frequents salt water.

Range: The Atlantic coast from New York to Florida.

Local distribution: Salt marshes in the vicinity of Long Island Sound, Staten Island and New Jersey.

The Painted Turtle, *Chrysemys picta* (Figs. 38 and 39), is one of the most common of the local species and is easily recognized.

Painted Turtle. The general color above is dark olive or black, with the margins of the shields of a paler shade. The margin of the under side of the carapace is black, with bright red markings; the plastron is yellow. Limbs, tail and neck, black, lined with red; head, lined with yellow. The shell of this species is flat and smooth; about five inches is the normal length.

Abundant in the vicinity of ponds, streams and marshes, these turtles may be often seen on floating logs or the like, from which they plunge quickly if alarmed. The food consists principally of small fishes and insects. Captive specimens thrive on raw chopped meat or fish.

Range: North America from New Brunswick to Georgia.

Local distribution: General and abundant.

Muhlenberg's Turtle, *Chelopus muhlenbergii* (Figs. 40 and 41), which somewhat resembles the Spotted Turtle (*Chelopus guttatus*),

Muhlenberg's Turtle. may be easily distinguished from the latter species by the brilliant orange spot on each side of the head. The carapace is dark brown or black, sometimes marbled with light brown; the shields often show lighter margins. The shell is black beneath, blotched with yellow. The spot on each side of the head is quite characteristic. It is



FIG. 40. MUHLENBERG'S TURTLE



FIG. 41. MUHLENBERG'S TURTLE

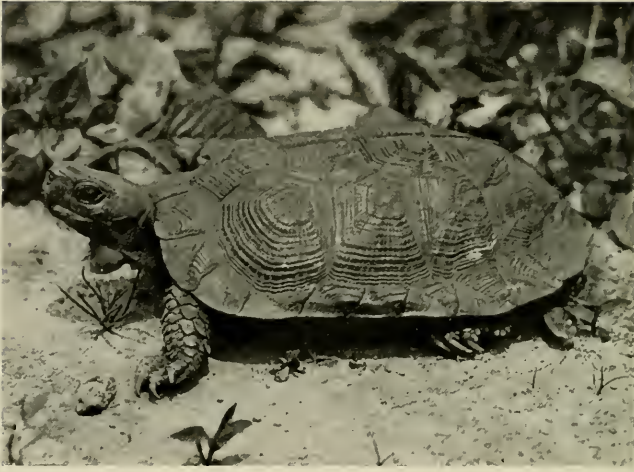


FIG. 42. WOOD TURTLE



FIG. 43. WOOD TURTLE ; ON ITS BACK

situated a little behind the eye and slightly above the region of the ear. The species is very rare in this vicinity. An adult specimen will measure four inches in length.

Range: Southern New York, New Jersey and eastern Pennsylvania.

Local distribution: Recorded from Staten Island and the Palisades of the Hudson River. Frequents shallow streams and swamps.

The Wood Turtle, *Chelopus insculptus* (Figs. 42 and 43), sometimes called the Wood Tortoise, is a species quite terrestrial in habits. The general aspect of the carapace is rough, the plates being raised in concentric rings, and there is a distinct keel down the back. The color is brownish above, irregularly and rather indistinctly marked with yellow or light brown; the plastron is reddish yellow with a blotch of black on each plate; limbs, neck and fleshy parts tinged with salmon red. The head is uniform brown.

Wood
Turtle.

Although never found far from the vicinity of water, this species is not a water turtle, but prefers to roam about on swampy ground. In habits it resembles the Box Tortoise (*Cistudo carolina*), feeding largely upon vegetable matter. The Wood Turtle attains fairly large dimensions, the length of an adult specimen being eight inches.

Range: The northeastern United States.

Local distribution: General in swampy districts, but not common.

The Spotted Turtle, *Chelopus guttatus* (Fig. 44), rivals the Painted Turtle in being the most common of the local chelonians. The shell is smooth and black above with numerous round, yellow spots which vary in number on different individuals. The plastron is yellow, blotched with black. The average length of an adult specimen is four inches.

Spotted
Turtle.

Range: Maine to South Carolina; westward to Ohio.

Local distribution: General and abundant.

The Box Tortoise, *Cistudo carolina* (Figs. 45, 46 and 47), is a strictly terrestrial species. The plastron is provided with a remarkable, practical double hinge, which is employed for pro-



FIG. 44. SPOTTED TURTLE



FIG. 45. BOX TORTOISE

tection in time of danger. When the reptile is annoyed, the front and rear sections of the plastron are pulled upwards towards the carapace, and so closely do the two shells come together that it is difficult to insert even a fine wisp of straw at any point between them.

Box
Tortoise.

The Box Tortoise lives to great age, as is shown by the fact that specimens have been found upon the shells of which were names and dates that had been carved there sixty and seventy years before. Such tortoises were found near the fields in which



FIG. 46. BOX TORTOISE ; ON ITS BACK

they lived when marked, hence the probability is that the animal is not a great traveler. During very dry seasons the Box Tortoise has been known to abandon the surface of the ground and burrow deeply into moist earth or mud.

Extremely variable in coloration, although the general colors are brown or black, irregularly marked with yellow, the species is more readily recognized by its form. The carapace is arched and high; the limbs are club-shaped and fitted for a terrestrial existence. Male specimens may be recognized by a distinct concave area on the rear section of the plastron and by their

red eyes. The Box Tortoise is largely herbivorous. It is very fond of berries. The length of an adult specimen is about six inches.

Range: The eastern United States.

Local distribution: General and common.



FIG. 47. BOX TORTOISE WITH CLOSED PLASTRON



BULL FROG. NEARLY NATURAL SIZE
From specimen in New York Zoological Park
Fig. 1 of the article on Batrachians

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THE major portion of this number of the JOURNAL is devoted to illustrated descriptions of the salamanders, toads and frogs which have been found within a radius of about 50 miles of New York City. This article will be published separately as No. 20 of the Museum series of Guide Leaflets, and is intended for use as a handbook for the identification of the animals in their wild state as well as in connection with the collections on exhibition in the Museum.

The collection illustrating the local batrachians may be found at present in the Synoptic Hall, No. 107 of the ground floor of the Museum Building.

The Museum gratefully acknowledges the coöperation of the New York Zoölogical Society in the preparation of the Guide. The author is Mr. Raymond L. Ditmars, Curator of Reptiles in the New York Zoölogical Park, Bronx Park, who also prepared the leaflet upon the local reptiles which was issued with the preceding number of the JOURNAL. Through Director W. T. Hornaday the abundant living material of the Zoölogical Park was placed at the disposition of the Museum for the purpose of making photographs for the illustrations, and through Director C. H. Townsend similar courtesies were extended at the New York Aquarium, Battery Park. The source of the illustrations is indicated under each figure.

THE Department of Geology has acquired a complete series of the rocks and corresponding thin sections to illustrate the latest edition of Rosenbusch's "Elemente der Gesteinslehre." This collection has been placed among the study series of the Department, where it may be examined by those interested in the subject of petrography.

HOW THE QUEENS OF THE PARASITIC AND SLAVE-MAKING ANTS ESTABLISH THEIR COLONIES.



CONTINUATION of the author's study of temporary social parasitism among ants, briefly noticed a year ago in the AMERICAN MUSEUM JOURNAL (Vol. IV, p. 74), has brought to light some interesting facts concerning the establishment of formicaries in several of our species. It is now well known that an ant colony is started by a single fertilized female, or queen. This insect, after mating high in the air during her nuptial flight, descends, pulls off her wings, and proceeds to dig a tiny nest in the ground or in rotten wood. She closes the entrance behind her and remains secluded and without food for nine or ten months, while she lays a packet of eggs and cares for the larvæ when they hatch. Until the larvæ mature as workers, the queen feeds them with salivary secretion derived from her own fat-body and degenerating wing-muscles. These firstling workers are always small, because as larvæ they were insufficiently fed. They open the entrance to the nest, and go forth in search of food for their queen and themselves. The mother insect is now able to devote all her energies to assimilating nourishment and producing eggs, while the workers care for the brood and extend the galleries of the nest and give it whatever external architecture it may possess.

This method of colony formation, which is adopted by nearly all ants, may be called the typical method. There are, however, two other methods which are resorted to by the queens of certain species, one of a more complicated, or redundant, the other of a simpler, or defective type. The redundant type occurs among the leaf-cutting and fungus-growing ants (*Attii*) of tropical and subtropical America, in which the queen not only brings up a colony of workers by herself alone, but simultaneously keeps up a culture of the peculiar fungus which, so far as known, constitutes the only food of these ants. The defective type is found in certain ants whose queens, either because they are too small and infertile, or for some unknown reason, are unable to bring up a firstling brood without the assistance of workers of another

species. The latter method of colony formation appears under three aspects:

First, the queen may seek adoption in a moribund or queenless colony of another species and there have her young fed and reared by the alien workers. Later these die off and leave a pure colony of the parasitic species, which has now waxed sufficiently strong and independent, both in number and pugnacity, to hold its own in the struggle for existence. In the former note in the JOURNAL attention was first called to this type of temporary social parasitism in a Connecticut ant (*Formica difficilis* var. *consocians*) which, till its colony is established, lives with the common *F. schaufussi* var. *incerta*. During the past July the author was able to confirm and extend his observations on these insects. It was learned that queens of *F. consocians* were readily adopted by *incerta* workers, even when the latter had been isolated as pupæ and could not, therefore, have had any previous experience with the parasites. It was also discovered that workers of our common black ant (*Formica fusca* var. *subsericea*) could be induced to adopt solitary queens of the mound-building ant (*F. exsectoides*) and the fallow ant (*Formica rufa* subsp. *integra*). Hence it is probable that these species, which, of all our ants, develop the largest and most formidable colonies, start as humble temporary parasites in the nests of another species. Very recently Wasmann has shown that the author's conclusions are in all probability applicable also to the European ants of the *rufa* and *exsecta* groups.

The parasitic instincts of the queen ants belonging to the *rufa* and *exsecta* groups, which include *F. consocians*, *integra*, *exsectoides* and all the different forms of fallow ant (*F. rufa*) both of Europe and America, are probably traceable to a peculiarity of the adult colonies of these insects. It is known that these colonies sometimes consist of dozens of different nests, which have all been founded by young fertilized queens, accompanied by a number of workers of their own species, as offshoots from the original nest, that is, the one first established through temporary social parasitism. This habit of propagating a colony over several nests often many feet apart, has probably been the means of depriving the queens of the *rufa*

group of their primitive ability to establish colonies exclusively through their own initiative. Hence when, during their nuptial flight, they drift too far away to find workers of their own colony or species at hand to assist them, they are compelled to solicit the aid of workers of another species. The extremely common, widely distributed, and very cowardly ants of the *fusca* and *schaufussi* groups are the ones naturally exploited for this purpose. In the species of the *rufa* group with large queens we probably still have the earlier phylogenetic stages of this development: the parasitic instinct is highly developed, but the stature of the ants has as yet undergone little or no diminution. In the species with diminutive queens, however, like *F. neptacula*, *microgyna* and *consocians*, we have the last stages in this retrogressive development, since the inability of the queen to establish a colony unaided is manifested not only in her parasitic instincts, but also in her diminutive size and frail structure.

Second, the queen may not only seek adoption among alien workers, but she and her progeny may continue to live with their hosts as permanent parasites. This seems to be the case in some of the European ants of the genus *Strongylognathus* and in the workerless species of *Anergates*, *Epæcus*, *Epipheidole* and *Sympleidole*.

Third, the queen may compel her own adoption or may snatch away the pupæ of an alien species and leave to the workers that hatch from them the care of bringing up her own offspring. These may, in turn, take to robbing the worker pupæ from other colonies of the host species and in this manner keep up a permanent mixed colony. This is slavery, or "dulosis," as practiced by the sanguinary ants (*Formica sanguinea*) and the amazon ants (*Polycergus rufescens*) of Europe and their American subspecies and varieties.

Experiments on artificial colonies of *F. sanguinea* subsp. *rubicunda* Emery have given an insight into the method in all probability adopted by this insect while founding its colonies under natural conditions. A detailed account of these experiments will be published in the near future, but the results may be here briefly stated. When a female *rubicunda* from which the wings have been removed is confined in an artificial nest

with as many as twenty workers of *F. fusca* var. *subsericca* and their brood, she is received with great hostility. At first her conduct is patient and insinuating, or even somewhat timid, but the persistent pulling and tweaking to which she is subjected by the workers soon throws her into a frenzy of rage. She falls upon her tormentors, drives them from their brood and, when they persevere in returning, kills them one by one. With feverish haste she then appropriates the pupæ, secretes them in some corner and carefully guards them, ever on the alert with open mandibles to attack an intruder, till the workers are ready to hatch. She deftly frees the pale drab callow young from their pupal envelopes, and immediately adopts them, thus quickly surrounding herself with the means of nourishing both herself and her own progeny as soon as the latter are brought forth. The immediate result of these tactics is to produce a small mixed colony consisting of a female of one species of *Formica* and a number of workers of another, exactly as in the *consocians-incerta* colony, but with the interesting and important difference that in this case the *incerta* workers are effete or moribund, or at any rate older than the queen, whereas the *subsericca* workers in the case of *rubicunda* are younger than the queen and have before them a lease of life amounting to three or four years. The result, moreover, in the case of *rubicunda* is not achieved passively, by adoption of the queen, as in *consocians*, but actively, by conquest and abduction. Of course, none of these differences is apparent from mere inspection of an incipient mixed colony of *consocians* or *rubicunda*, but can be ascertained only through studying the behavior of the queen during the period that elapses between the nuptial flight and the establishment of her colony.

The author's experiments with queens of our shining amazon (*Polyergus rufescens* subsp. *lucidus*) and workers of the species which it enslaves (*Formica schaufussi*) have, up to the present time, given contradictory results. All of these queens, when introduced into artificial nests containing *schaufussi* workers, were violently attacked. Some of them retaliated by ruthlessly killing all the latter, but remained perfectly indifferent to their larvæ and pupæ. Other queens, however, were more insinuating and far less bloodthirsty and, though equally indifferent

to the *schaufussi* young, seemed to be seeking adoption. Perhaps the method of colony formation resorted to by these insects may vary according to circumstances. It is certain, however, that the establishment of a colony must be attended with great difficulties or be possible only under unusual conditions, since the amazon ants are very rare and local in their occurrence.

WILLIAM MORTON WHEELER.

CIRCULATING INSECT COLLECTIONS.

A notable addition to the circulating school collections is the special insect collection, fifty sets of which have been prepared. Each collection consists of four trays, 9 x 7 x 1½ inches, which are made so that they can be removed from the transportation case and passed around the class. The first tray shows the life history of the Cecropia Moth, comprising eggs, caterpillar, chrysalis, cocoon and adult. Since it is impossible to preserve the caterpillar in a lifelike condition, there has been substituted for it a hand-colored lifesize photograph showing a caterpillar on the twig of an alder, one of the many plants upon which it feeds. This photograph serves as a background for the group. To one of the leaves are attached the eggs, and the moth is mounted as if alighting on the alder twig. The second tray contains the development of the Monarch or Milkweed Butterfly for comparison with the Cecropia. A hand-colored photograph from life shows the caterpillar (natural size) feeding on a spray of milkweed. In the third tray is shown the life and work of the Honey Bee. The series contains queen, drone, worker, larva, pupa, drone cells, section of drone cells, worker cells, section of worker cells, queen cells, wax, propolis, artificial foundation, honeycomb ready to receive the honey, cells filled with honey and a vial of pure honey. The fourth tray shows the household-insects and contains fourteen species of our most common household pests, including the house-fly, roach, clothes moth, mosquito and some species particularly familiar in crowded tenement districts. The notes which accompany each collection give the habits and economic importance of the insects, and, in the case of the household pests, the best methods of exterminating them.

DEPARTMENT OF PREPARATION AND INSTALLATION.



E present with this number illustrations of the enlarged models representing the anatomy of the common oyster and clam, which have been prepared by Dr. B. E. Dahlgren, Curator of the Department, and placed on exhibition in the Synoptic Hall, No. 107 of the ground floor. These models are about seven times natural size, and show very clearly the names and functions of the different parts of the animal.



CLAY MODEL OF POLAR BEAR GROUP

The preparation of a large group to represent the Polar Bear in his native surroundings has been begun by the Department of Preparation and Installation. It may interest our readers to know that the first step in the actual preparation of such a group is the making of a complete model in clay, which represents not only the background, but also all the animals in the position and attitude which they will occupy in the completed work. A photograph of such a preliminary model of the Polar Bear group is reproduced herewith. The animals here utilized were captured on some of the Peary Arctic expeditions.

Several striking and instructive models in glass, wax and other materials have been placed on exhibition in the Synoptic

Hall, No. 107 on the ground floor. The models represent the anatomy of the Nemertean, one of the worms, enlarged about 15 diameters; Porpita, a form related to the Portuguese Man-of-War, enlarged about 10 times; a Cladactis, which is a beautiful sea-anemone flourishing in the Gulf of Naples; a Sea-fan, enlarged 3 diameters; a Goniomus, one of the jellyfishes, enlarged 6 or 8 diameters, and some of the Bryozoa, much enlarged.

A group illustrating the Peccary has been installed in the East Mammal Hall, No. 206, which was prepared in the Department from animals collected by J. H. Batty and accessory material collected by Dr. B. E. Dahlgren.

Among other groups which have been recently prepared at the Museum and placed on exhibition mention may be made of that representing the Iguana, the great edible lizard of tropical America, and that of a poisonous lizard closely allied to the Gila Monster. The animals for these groups were collected in Mexico by Mr. J. H. Batty.

MUSEUM NEWS NOTES.



LARGE specimen of the Leather-back Turtle (*Dermochelys coriacea*) was received in the flesh early in July as a gift from Messrs. G. M. Long & Co., New London, Conn. The dimensions of the animal were, carapace, 4 feet 10 inches long; body, 6 feet long over all; spread of flippers, 7 feet; weight as determined at the Museum, 716 pounds. A plaster cast of the specimen was made at once, which will soon be placed on exhibition. The turtle was harpooned about 30 miles east of Block Island by Captain Hoyt, of the fishing-smack Lizzie M., of Bridgeport, Conn., while on a cruise for sword-fish.

THE Museum has recently received from Alaska the material for completing the group of the Alaska Brown Bear. The animals were collected on Museum expeditions by Mr. Andrew H. Stone. The accessories were kindly collected and presented by Mr. H. B. Scott, of Sand Point, Alaska.

THE St. Louis World's Fair Exhibit of the New York City Board of Education, which was displayed for several months at

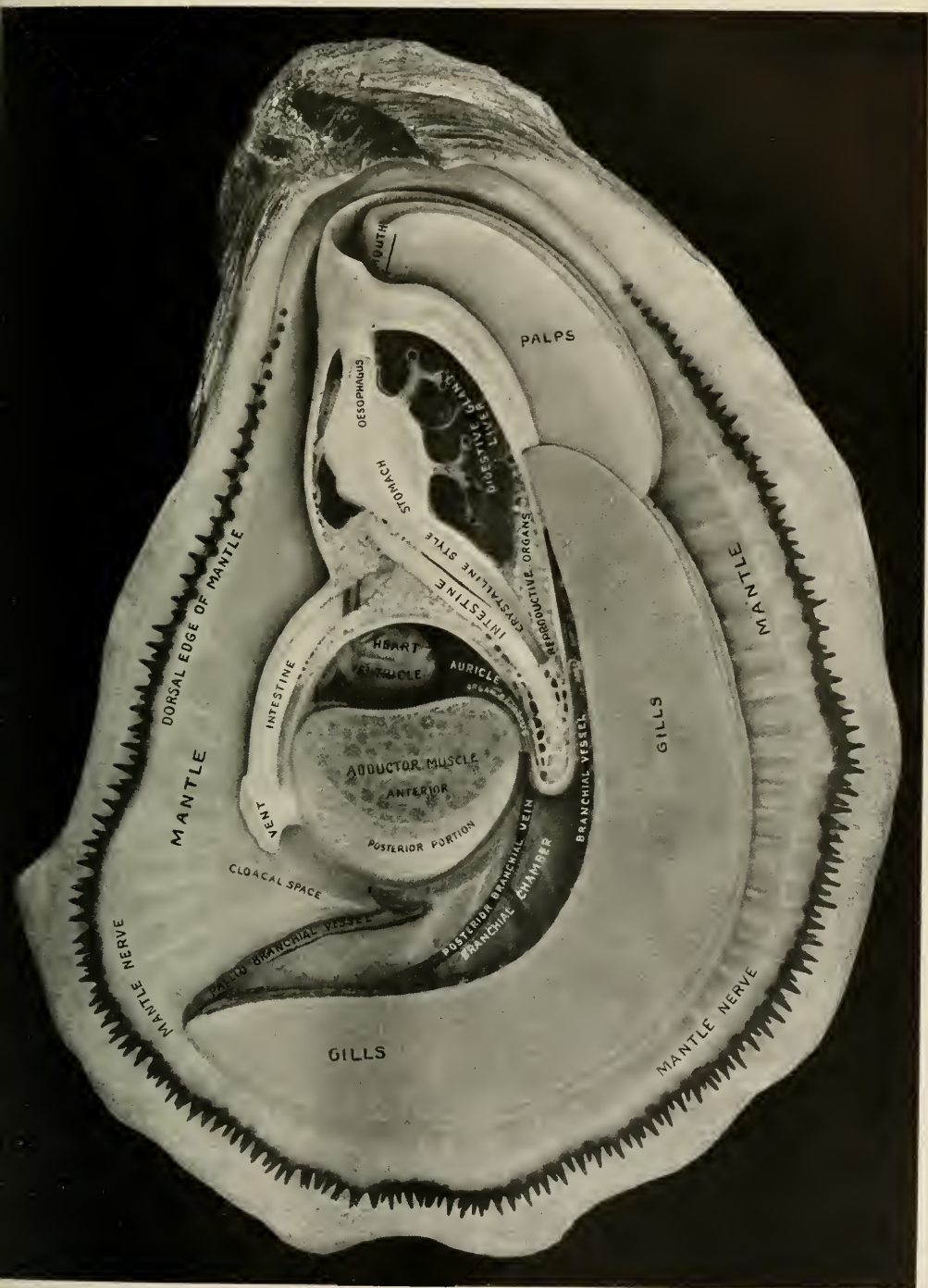
the Museum and which attracted thousands of visitors, has been removed.

THE New York City Board of Health has installed in the West Assembly Hall on the ground floor of the Museum the material which formed its exhibit at the Louisiana Purchase Exposition in St. Louis last year.

THERE has been a greater demand than ever on the part of the vacation schools for our nature-study collections which are loaned to public schools. Thirty-two out of the thirty-three vacation schools in session during the summer have been supplied with collections, and, according to data furnished by the teachers, they have been studied by more than 40,000 school children. This number makes a total of 365,000 children who have studied the collections during the past school year.

At the request of the Librarian of the 176th Street Branch of the New York Public Library, the Museum has loaned a collection, consisting of local birds, insects and marine animals, for exhibition in the reading-room of that branch. In response to a similar request, an archæological collection has been placed in the Tompkins Square Branch, East Tenth Street. In this collection are shown the stone and bone implements that were made and used by the prehistoric Indians. The collections have proved so interesting and instructive to adults as well as to children, that Dr. Arthur E. Bostwick, Chief of the Circulating Department, has asked for the extension of similar privileges to other branch libraries.

At a meeting of the students of the Summer School of Columbia University, held at the Museum on July 26, Mr. George H. Sherwood gave an informal talk on the Museum's work of loaning nature-study collections to public schools and of giving lectures for school children. Mr. F. M. Chapman spoke on Museum methods in the collecting of scientific data and materials, with special reference to his studies in the flamingo colonies of the Bahama Islands. Mr. Chapman illustrated his talk with lantern slides made from some of the remarkable photographs



THE ANATOMY OF THE COMMON OYSTER
 From model about seven times natural size prepared by DR. B. E. DAHLGREN

taken by him in the field. After the lecture the students were taken to the flamingo group and were shown some of the practical results of the expedition which had been described. The majority of the students were public school teachers from Southern and Western States, and they were much interested in these phases of the Museum's work.

THE generosity of a friend of the Museum enables the Department of Ornithology to plan to assemble a special collection of Birds of Paradise. Many species of this remarkable family of birds are now becoming so rare that specimens can be secured only with difficulty. Mr. Chapman, Associate Curator of Ornithology, while attending the Fourth International Congress of Ornithologists in London recently, took advantage of the occasion to examine the stocks of London dealers in Natural History supplies and was fortunate in procuring some most desirable material for use in the proposed group.

THE collections of native birds were so popular last year that the Museum was unable to fill all the requests for them. The duplicate material in our study collections which could be used for this work has long since been exhausted, and during the summer the Museum has purchased more than six hundred bird skins to supplement our present collections. These have been mounted, and there are now two hundred cabinets of birds alone available for school use.

MR. J. H. BATTY, who has been collecting mammals, birds, and reptiles for the Museum in Mexico for several years past, finished his work in southern Sinaloa in November last, going thence overland through Tepic to Jalisco, where he has since been making important collections. Several shipments from Jalisco have already reached the Museum, containing hundreds of birds and mammals, besides many reptiles and insects, accessories for groups and a large number of valuable photographs. During the last two or three months he has been exploring the fauna of Mount Colima and the adjacent regions, with very interesting results. His collections of birds and mam-

imals thus far received number several thousand of each and include several hundred specimens of the large mammals, such as Deer, Peccaries, Coyotes, Coatis and Ocelots. He has shown himself particularly successful in hunting large game, and his industry and endurance often attain success where a less energetic and less resourceful collector would meet with failure.

LIEUTENANT G. T. EMMONS, of the United States Navy, retired, has deposited in the Museum several remarkable specimens from Lytton, British Columbia, which are different from anything known from there in 1897, when the monograph on the Archæology of Lytton was published by the Museum in 1897.

THE Royal Ethnographical Museum of Berlin has sent, for exchange with the Museum, six casts of sculptured clubs made of whale bone, from Vancouver Island. These have been drawn for illustration, for comparison with specimens collected by the Jesup Expedition, in one of its forthcoming monographs, wherein will be portrayed as complete a series of such clubs as it is possible to obtain.

THE Museum has received from the Missouri Historical Society, as a gift, a model of the Cahokia Mound in Madison County, Illinois, as it was in 1878. This mound is of the form of a truncated pyramid and is the largest in the United States, being some 1100 feet long and more than 100 feet high. It covers more ground than the largest Egyptian pyramid. With this model was another, made by Mr. John R. Patrick, showing the mound restored to its supposed original form.

THE Department of Anthropology has received as a gift from Mr. T. Van Hyning of the State Historical Department of Des Moines, Iowa, a series of grooved axes, celts and stone disks which is particularly welcome, since the Museum previously had only two archæological specimens from that State.

MR. DAVID ASHWORTH, of Wappinger's Falls, New York, has kindly loaned to the Museum a series of characteristic archæological specimens collected by him at the time of the construction

of the Canadian Pacific Railroad through British Columbia. Such of these as supplement the large collection made by the Jesup expedition are being cast and the casts are being colored for exhibition in the Museum. These specimens are also being illustrated and described for publication in a memoir of the Jesup expedition on the Archæology of Puget Sound.

MR. FRANK G. SPECK, who has been engaged in field work in Indian Territory for the Department of Ethnology, has suffered sunstroke. While he is not in danger of his life, this unfortunate occurrence will greatly interfere with the work for which he is particularly fitted.

DR. P. E. GODDARD, of the University of California, has completed the field work in Ethnology which he undertook last summer among the Sarcee Indians of Canada for the American Museum. His collection, which has been received here, includes several important medicine objects.

MR. W. C. ORCHARD has made a number of tepee models, showing the methods of tying the poles, decorating the outside and arranging and furnishing the interior. These have been installed in the west wing, ground floor. In the same hall an exhibit has been made of a Blackfoot Medicine Pipe, showing its place in the tepee when in use, together with the numerous objects pertaining to it. This medicine outfit has an elaborate ritual with seventy songs, all of which have been recorded with a phonograph and preserved by the Museum.

MR. R. H. LOWIE has installed an exhibit of primitive fire-making in the West Wing of the second floor (Hall No. 202). Since it was by the use of fire that mankind advanced from a merely animal mode of life to the present level of material culture, an exposition of the methods by which the different peoples obtained fire forms the first chapter in the history of civilization. This exhibit demonstrates the fact that practically all people used some kind of wood friction to get the first spark of artificial light and heat.

AN unusually fine collection of Orthoptera has been purchased from Prof. Lawrence Bruner, of Lincoln, Nebraska. The collection contains 255 species and about 825 specimens.

LECTURES.

MEMBERS' COURSE.

THE first course of lectures for the season 1905-1906 to members of the American Museum of Natural History and those holding complimentary tickets given them by Members, will be given according to the following programme. The lectures will be delivered by members of the scientific staff of the Museum and will be fully illustrated by stereopticon:

Thursday evenings at 8.15 o'clock.

November 9.—MR. FRANK M. CHAPMAN, "The Bird Life of Florida."

November 16.—MR. LOUIS P. GRATACAP, "Newfoundland: Its Scenery and People."

November 23.—DR. EDMUND OTIS HOVEY, "Northern Mexico: Its Deserts, Plateaux and Canyons."

December 7.—PROFESSOR HENRY FAIRFIELD OSBORN, "The Museum's Rocky Mountain Explorations of 1905."

December 14.—PROFESSOR ALBERT S. BICKMORE, "The Philippines—Manila."

December 21.—PROFESSOR ALBERT S. BICKMORE, "The Philippines—Luzon."

PUPILS' COURSE.

THE lectures by members of the scientific staff of the Museum to pupils of the public schools and children of Members of the Museum will be resumed about the middle of October. The course, which is on topics supplementary to school work in nature study, geography and history, consists of twelve lectures, each of which is given three times. The lectures will be delivered Mondays, Wednesdays and Fridays at 4 P.M., and will be open to public-school children when accompanied by their teacher, and to the children of Members on presentation of their membership ticket. Additional particulars may be learned by addressing the Director of the Museum.

PEOPLE'S COURSE.

THE programme of the Free Lectures to the people which are given Tuesday and Saturday evenings in co-operation with the Department of Education of the City of New York for the first course of the season 1905-1906 is as follows:

Twelve lectures upon European geography, all illustrated by stereopticon views, on Tuesdays at 8 P.M.

October 3.—MR. FREDERICK E. PARTINGTON, "Sweden and Denmark."

October 10.—MR. FREDERICK E. PARTINGTON, "Norway."

October 17.—DR. JOHN C. BOWKER, "Japrussa." A Comparative Study of Russia and Japan.

October 24.—MR. FREDERICK E. PARTINGTON, "Imperial Austria."

October 31.—MR. FREDERICK E. PARTINGTON, "The Dolomite Alps and the Southern Tyrol."

November 7.—MR. E. CLOWES CHORLEY, "A Tramp through Switzerland."

November 14.—PROF. HENRY ZICK, "The Rhine and the Black Forest."

November 21.—PROF. HENRY E. NORTHROP, "Imperial Berlin."

November 28.—DR. WILLIAM E. GRIFFIS, "The Dutch at Home, and their Grand Story."

December 5.—DR. WILLIAM E. GRIFFIS, "Social, Artistic and Literary Holland."

December 12.—MR. ERNEST R. HOLMES, "Paris, City of Light."

December 19.—MR. ERNEST R. HOLMES, "How France is Governed."

Twelve lectures upon natural science on Saturdays at 8 P.M.
A course of six lectures on Evolution by PROF. SAMUEL C. SCHMUCKER:

October 7.—"A Master Mind." An account of the life and work of Charles Darwin.

October 14.—"His Master Idea." Natural Selection.

October 21.—"Down through the Past." Geological History.

October 28.—"What a Chicken can Teach us." Illustrated.

November 4.—"The Humming Bird's History." Illustrated.

November 11.—"The Flower's Best Friend." Illustrated.

Three illustrated lectures on the Industries of Animals by PROF. CHARLES L. BRISTOL:

November 18.—“Hunting and Fishing.”

November 25.—“Methods of Defence and Care of Young.”

December 2.—“Construction of Dwellings.”

Three illustrated lectures on Forestry by MISS GRACE E. COOLEY:

December 9.—“How the Forests Pay their Rent.”

December 16.—“The Struggle for Existence from the Standpoint of a Tree: Ingenious Methods of Winning Success.”

December 23.—“Forestry and the Citizen.”

The lectures of the People's Course are open free to the public, and no tickets are required for admittance, except in the case of children, who will be admitted only on presentation of the ticket of a Member of the Museum. The doors are open at 7.30 and are closed when the lectures begin.

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home will be resumed the first week in October. Papers on technical and general scientific subjects are read before these societies. The papers and discussions are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and Members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences will begin its sessions for the season of 1905-1906 on Monday, October 9, at 8.15 P.M., with a business meeting and meeting of the Section of Geology and Mineralogy. The programme will be as follows:

PROFESSOR ROBERT T. HILL, formerly of the United States Geological Survey, will lecture on “The Republic of Mexico: Its Physical and Economic Aspects.” Professor Hill has devoted more than twenty years to the study of Mexico, and his lecture embodies the results of extended, careful, and systematic research. The attention of the general public is particularly called to this meeting of the Academy, and those interested in our sister republic are cordially invited to attend. The lecture will be given in the Auditorium, and will be fully illustrated with stereopticon views.

The Academy meetings for the remainder of the month will take place as follows:

October 16.—Section of Biology.

October 23.—Section of Astronomy, Physics and Chemistry.

October 30.—Section of Anthropology and Psychology.

After October throughout the season the Academy will hold its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Geology and Mineralogy.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

On Tuesday evenings, as announced by the secretaries, meetings are held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.

THE BATRACHIANS OF THE VICINITY OF NEW YORK CITY.¹

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INTRODUCTION.



FOLLOWING the reptiles in zoölogical classification come the batrachians, creatures which may be said to constitute a connecting link between the reptiles and the fishes. Unlike the former, the great majority of batrachians begin life as strictly aquatic, fish-like forms, provided with gills, which with many species are elaborately developed in the shape of external, fringed processes. From this aquatic form, with gills (the tadpole or larval stage), the average batrachian ultimately matures into a creature constituted to breathe atmospheric air.

Swamps and bogs and the borders of streams and ponds are usually the homes of the batrachians, which thrive in such damp situations. Some species, like the toad, are quite terrestrial, and many are subterraneous, but with few exceptions they frequent the immediate vicinity of water or damp and shaded places. There are species that remain aquatic throughout life, like the Mud Puppy (*Necturus*) and the Hellbender (*Cryptobranchus*), both North American species. In the Old World is found the *Proteus*, a blind and translucent species, that passes its entire existence in underground rivers or in the dark lakes of European caverns.

¹ Issued also in separate form as **Guide Leaflet No. 20.**

With but few exceptions the mature batrachians differ from the reptiles in the total absence of scales. Their naked, usually slimy skin at once defines them to the novice. The few scaled species indicate their scalation only upon close examination, and beneath the shining skin may be discerned a fine dermal texture. No species among the local batrachians possesses scales.

In our local fauna, two orders of the Batrachia are represented. These are the *Urodela*, comprising Salamanders and Newts, and the *Salientia*, or Tailless Batrachians (the Toads and Frogs).

SALAMANDERS.

Order *Urodela*.

The salamanders and the newts may be easily recognized by their lizard-like form, but even the novice may at once distinguish them from true lizards by their moist or slimy, naked skin, totally devoid of scales. Many of the semi-aquatic species, however, are actually known in the regions they inhabit as water "lizards."

The majority of the local species begin life, like the frogs and toads, as tadpoles, hatching from opaque eggs which are deposited in streams and ponds. Unlike the frog larva however, the tadpole of the salamander retains throughout the larval state external gills, arranged in three tufts on each side of the head. These gills are delicately fringed and enable the young creature to lead a fish-like existence. The presence of these organs enables the observer to distinguish at a glance the larvæ of the salamanders and newts from those of the frogs and toads. Apart from the gills, however, the salamander tadpoles differ from the tailless batrachians in the development of the limbs. The front limbs are the first to appear, an external character quite reversed among the frog larvæ. Though the development with the latter is the same as with the salamanders, the growth of the front limbs goes on under cover of the operculum, while the hind limbs are attaining external development. When the front limbs attain their growth, they push their way suddenly through the folds of the operculum and into view.

A few of the local salamanders, represented by the genera

Plethodon and *Hemidactylum*, undergo their metamorphosis in damp places under stones or logs in the woods. The young of these possess branching gills when hatched, but the gills are absorbed within a few days.

In the vivarium, many of the salamanders may be kept for observation by providing them with some three inches of damp *Sphagnum* moss, over which have been placed strips of old bark. The moss should be kept very damp. Ant larvæ, the grubs of the smaller wood-boring beetles and small earthworms serve as food.

If these creatures were provided with scales like the reptiles, the making of a popular key for identification would be simple. There is, however, among most salamanders a peculiar uniformity of external surface and general structure. Technical divisions of the *Urodela* are founded upon the arrangement of the teeth, the anatomical structure of the tongue, the shape of the tail and the development of the toes. In the preparation of the following key, however, the writer has relied upon the few characters that appeal to an observer not versed in technical terms. The characters employed pertain to variation of *outline*, where such exists, *size* and *color-pattern*. In our local fauna four families, comprising twelve species and two varieties, are represented. These are, the AMBLYSTOMIDÆ, represented by *Amblystoma opacum*, *A. tigrinum*, *A. punctatum*; the PLETHODONTIDÆ, *Plethodon glutinosus*, *P. cinereus*, *P. cinereus erythronotus*, *Hemidactylum scutatum*, *Spelerpes ruber*, *S. bilineatus*, *S. longicauda*; the DESMOGNATHIDÆ, *Desmognathus fusca*, *D. ocropheæ*; the PLEURODELIDÆ, *Diemyctylus viridescens*, *D. viridescens miniatus*.

Key to the Salamanders.

a. FORM STOUT, SIZE LARGE.

1. Tail flattened towards the tip.

Black, marbled with grayish

white blotches..... **Marbled Salamander** (*Amblystoma opacum*).

Black, marbled with yellow,

the yellow predominating... **Tiger Salamander** (*Amblystoma tigrinum*).

Black, two rows of yellow

spots, black predominating. **Spotted Salamander** (*Amblystoma punctatum*).

b. BODY CYLINDRICAL, ELONGATED.

1. Tail rounded.

Size moderate; black, with silvery spots. **Slimy Salamander** (*Plethodon glutinosus*).

Size very small; brown, with minute white dots. **Gray Salamander** (*Plethodon cinereus*).

Size very small; dark gray, a reddish band on back. **Red-backed Salamander** (*Plethodon cinereus erythronotus*).

2. Tail bluntly oval.

Size small; snout very blunt; brown, paler on back. **Four-toed Salamander** (*Hemidactylum scutatum*).

3. Tail flattened towards the tip.

Size moderate; bright red, spotted with black. **Red Salamander** (*Spelerpes ruber*).

Size small; yellow band on back, dark bands on the sides. **Two-lined Salamander** (*Spelerpes bilineatus*).

Size larger; yellow, sides with many black spots and a median dorsal series thereof; tail keeled above, very long. **Long-tailed, or Cave Salamander** (*Spelerpes longicauda*).

Size moderate; gray, minutely dotted with white; greater length of tail flat. **Dusky Salamander** (*Desmognathus fusca*).

Size moderate; brown, lighter on head; basal half of tail rounded. **Mountain Salamander** (*Desmognathus ochrophæa*).

c. OUTLINES WELL PROPORTIONED; SIZE SMALL.

1. Tail flat from base to tip.

Skin smooth; tail fin-like; olive above, yellow beneath, a row of red spots on side; aquatic. **Water Newt** (*Diemyctylus viridescens*).

Skin rough; tail thicker; reddish brown to vermilion; terrestrial. **Red Eft; Mountain "Lizard"** (*Diemyctylus viridescens miniatus*).

DESCRIPTIVE LIST OF THE SALAMANDERS.



FIG. 2. THE MARBLED SALAMANDER
From specimen in New York Aquarium

The Marbled Salamander, *Amblystoma opacum* Gravenhorst (Fig. 2), is of moderate size and stout form, with flattened tail, which is thick at the base. General color slaty-black, with large elongated spots or blotches of grayish-white on the back and head. Some of the spots run together, producing a marbled appearance, a character which occurs on the back of many specimens. The spots are regularly disposed as half-rings on the upper surface of the tail, producing a banded appearance. Beneath, this species is a uniform bluish-black. It may be distinguished from the other local representatives of the genus by its grayish-white markings, the other species possessing yellowish markings. Total length, $4\frac{3}{4}$ inches; length of tail, 2 inches.

Range: The eastern and central portions of North America.

Local Distribution: General in this vicinity, but not common.

The larvæ of the marbled Salamander may be found in shallow ponds in the openings of woods. They grow rapidly and leave the water late in June or early in July. While developing, they present a dull, grayish appearance, thickly dotted with white, which pattern gives way to the markings of the adult a short time prior to their leaving the water. In the adult form this salamander selects dry situations, and may be found under stones in sandy, or dry and hilly country, where it burrows to some depth.



FIG. 3. THE SPOTTED SALAMANDER
From specimen in New York Zoological Park

The Spotted Salamander, *Amblystoma punctatum* Linn. (Fig. 3), is a large form with stout body and broad head. The tail is rounded at the base, but bluntly compressed towards the end. Black above, with a row of round brilliant-yellow spots on each side. This row extends to the tip of the tail and is a ready means of identification. There are several of these spots, too, on the upper surface of each limb. The lower sides are slaty-gray, sprinkled with small, bluish-white spots. In form the Spotted Salamander slightly resembles the Tiger Salamander, but may be distinguished therefrom by the

regularity of its color pattern. Total length, $7\frac{1}{2}$ inches; length of tail, $3\frac{3}{4}$ inches; width of head, $\frac{3}{4}$ inch.

Range: Eastern and central North America.

Local Distribution: Sparing, in damp woods.

The eggs are deposited early in the spring in ponds and small streams. They resemble the spawn of frogs. The adult may be found under logs and stones in thinly timbered sections. Like the other species of this genus, this salamander will live for years in the vivarium.



FIG. 4. THE TIGER SALAMANDER
From specimen in New York Zoölogical Park

The Tiger Salamander, *Amblystoma tigrinum* Green (Fig. 4), is a large species with stout body, flat head and compressed tail. Ground color above, dark brown or gray (sometimes black), thickly covered with large, irregular, yellowish blotches. The blotches predominate and impart a marbled appearance to the animal. On the lower portions of the sides the yellow is present in the form of round spots, or scattered blotches, and the ground color is lighter. The chin is thickly marked with yellow, but little of the color is apparent on the abdomen, which is gray. The intensity of the markings depends much upon the age of the individual. Very old specimens show a faint pattern and in some lights appear to be of a dull, uniform

**Tiger
Salamander.**

brown. This is the largest of our salamanders. Although in form resembling the Spotted Salamander, its blotched appearance makes identification easy. The limbs are large and well developed. A mature specimen from New Jersey shows a total length of $8\frac{1}{2}$ inches; the tail is $3\frac{3}{4}$ inches long, and the head $\frac{3}{4}$ inch wide. The species is said to attain a length of eleven inches.

Range: The entire United States and southern Canada; northern and central Mexico.

Local Distribution: Rare, but found occasionally on Long Island and in New Jersey.

Although one of the rarest of the local batrachians, the Tiger Salamander is our most interesting species. The metamorphosis from the larval to the adult form depends largely upon light and temperature, and is strongly influenced by surrounding conditions. In the western and southwestern portions of the United States it is abundant, and throughout those areas, for many years, its larval or tadpole stage was thought to constitute a distinct species, the Axolotl. In permanent lakes of some depth, where the water remains moderately cold and there is abundance of food suitable for the larval form, this creature evinces an interesting persistency in retaining the branching gills (branchiæ) and continues its aquatic existence for indefinite periods even attaining the size of the terrestrial form.

More remarkable, however, than tardy metamorphosis is the fact that during this evidently larval state these creatures breed and deposit eggs. In this aquatic form the species has had several different names. In the case of an evaporating pool, slowly drying away under the summer sun, the larva finds an opportunity along the shallow borders frequently to employ its nostrils at the surface of the water, with the result that the gills become degenerated and transformation is hastened.

Adult specimens secrete themselves in burrows, not far from the vicinity of water, although they may be occasionally found hiding under decaying logs, in very moist situations. They prey upon insects and worms, and they even attack larger creatures, when within reach. A specimen in the writer's collection devoured several very young field mice. Hiding by day, they prowl during the hours of darkness or during rains.

The Four-toed Salamander, *Hemidactylium scutatum* Tschudi (Fig. 5), is small, with cylindrical body and very bluntly oval tail. Color above, deep reddish brown; about the head, especially on the snout, there is a lighter shade, approaching bronze. Close examination of most specimens will reveal the presence of numerous dark spots on the upper surfaces. The sides of the body present a mottled ap-

Four-toed
Salamander.



FIG. 5. THE FOUR-TOED SALAMANDER
From specimen in Am. Mus. Nat. Hist.

pearance, and the ground color is much lighter than on the back. The entire under surface is bluish-white, with a few, irregularly placed dark spots, presenting a strong contrast with the principal color.

This small species somewhat approaches the Gray Salamander in appearance, but may be distinguished therefrom by its very blunt snout and proportionately shorter tail. The back and the sides are strongly marked with furrows, a feature in which the species is quite unique. The limbs are small and weak. There are but four toes on the hind foot. Total length, 3 inches; length of tail, $1\frac{1}{2}$ inches.

Range: The entire eastern portion of the United States.

Local Distribution: Mostly along the Palisades of the Hudson River.

The Four-toed Salamander, rather a rare species in this vicinity, is generally found in scattered companies. It is strictly terrestrial, and inhabits timbered regions, where it hides under logs and stones.



FIG. 6. THE GRAY SALAMANDER
From specimen in New York Zoölogical Park

The Gray Salamander, *Plethodon cinereus* Green (Fig. 6), is a small form, very slender and worm-like; tail round and long.

Gray Salamander. Color above, dark brown, grayish or black, sprinkled with minute silvery spots. Sides of the body lighter and speckled with dark gray. Abdomen pale gray, marbled with a darker shade. Total length, 3 inches. Diameter of body, $\frac{3}{16}$ of an inch.

Range: Southern Canada and the United States generally, east of the Mississippi.

Local Distribution: Particularly abundant on the Palisades of the Hudson River.

This very common little salamander is strictly terrestrial.

It may be found in numbers, hiding under flat stones and logs in damp woods. Although provided with very small and slender limbs, it displays remarkable agility when disturbed, either wriggling its way among fallen leaves, or progressing over them by a series of jumps caused by doubling its worm-like body into a series of lateral undulations and suddenly straightening itself.

The eggs are deposited under damp and decaying logs, in moss or under stones. When the minute larvæ emerge, they possess external gills, but these are absorbed within a few days'



FIG. 7. THE RED-BACKED SALAMANDER
From specimen in New York Zoölogical Park

time. The species is never aquatic at any stage of its life. It is easily distinguished from the other salamanders by its extremely slender body and perfectly round tail.

The Red-backed Salamander *Plethodon cinereus erythronotus* Green (Fig. 7), in size and dimensions is like the preceding form. Grayish on the sides with a bright reddish band on the back.

This band is wide, covering the greater portion of the back and extending towards the end of the tail, where it becomes obscure. The lower portions of the sides present a

Red-backed
Salamander.

thickly dotted appearance; the abdomen is grayish, marbled with darker gray. On some specimens the bright band on the back is sprinkled with small gray dots, but these are so minute that they scarcely produce a dull effect upon the color. On occasional specimens these dots fuse together, forming a dull line down the back, and imparting a resemblance to the markings of many specimens of the Two-lined Salamander. From the latter, however, the present species is at once distinguished by its round tail.

Range: The United States east of the Mississippi and southern Canada.



FIG. 8. THE SLIMY SALAMANDER
From specimen in New York Aquarium

Local Distribution: Generally abundant in damp woods.

This variety is commonly found with the typical form, and occasionally under the same logs and stones with the Slimy Salamander.

The Slimy Salamander, *Plethodon glutinosus* Green (Fig. 8), is of moderate size and rather slender, cylindrical form. The tail is round. Black above, thickly covered with irregular greenish-white, or lichen-gray spots, these often appearing like patches of silvery dust. Different specimens show great variation in the size of the patches, some being blotched with the light color, while others might be said to

Slimy
Salamander.

be finely speckled therewith. Lead color beneath, on which dull surface many specimens show numerous white dots. This species somewhat resembles the Marbled Salamander, but may be distinguished therefrom by its round tail and more numerous spots. It is, moreover, a more slender creature. The neck is much narrower than the head, causing the latter to look broad and flat, as in the larger salamanders (*Amblystoma*). Total length, 5 inches; length of tail, $2\frac{1}{2}$ inches.

Range: From Canada to Florida and westward to Texas.

Local Distribution: General and common. It is particularly abundant on the New Jersey side of the Hudson River, along the Palisades.

When handled, this salamander exudes through the skin a whitish mucus that adheres persistently, hence the technical name, *glutinosus*, and the common one, Slimy Salamander. It is a common species, preferring hilly or mountainous districts, where it leads an entirely terrestrial life, hiding under stones and logs in thickly timbered places, whence it issues at night or in rainy weather.

The Two-lined, or Yellow-backed, Salamander, *Spelerpes bilineatus* Green (Fig. 9), is a small, slender form, with flat tail. Yellowish on the back, which color is bordered on each side with a band of dark gray, brown or black. These bands start from behind the eye and extend down the tail. Beneath the bands the color is pale yellow, profusely sprinkled with dark spots. The broad, yellowish band, covering the back is often spotted with dark gray or brown, and on some specimens the spots run together down the back forming a narrow, dark line. The entire under surface is bright and immaculate yellow. The body is cylindrical; the tail decidedly compressed. Total length, $3\frac{3}{8}$ inches; length of tail, $1\frac{7}{8}$ inches; diameter of body, $\frac{1}{4}$ inch.

Two-lined,
or Yellow-
backed,
Salamander.

Distribution: General, very abundant in the beds of rocky brooks.

Range: From Maine to Florida, and westward to the Missouri River.

The Two-lined Salamander is an extremely active species. It

is usually found hiding under flat stones in the beds of brooks, not actually under water, but where the soil is thoroughly saturated with moisture. When disturbed in its hiding-places, it does not entirely depend upon its diminutive limbs for escaping from danger, but makes surprisingly rapid progress by doubling its body into a series of lateral undulations and suddenly straightening it. The result is a number of bewildering jumps. This performance is varied with a snake-like wriggling. Thus, with a combination of agile motions, the little animal makes like a flash



FIG. 9. THE TWO-LINED OR YELLOW-BACKED SALAMANDER
From specimen in New York Zoölogical Park

for the water and secretes itself among the stones. It is seldom seen except in the immediate vicinity of water, and the larvæ attain nearly the size of the adult before they begin an air-breathing existence.

The Long-tailed, or Cave, Salamander, *Spelerpes longicauda* Green (Fig. 10), resembles in form the Two-lined Salamander, but is a larger species and has a proportionately longer tail. The tail is much compressed and considerably longer than the body. The back is rich yellow, the sides paler. Scattered over the entire upper surface are coarse, black dots, which, on the sides of the tail

usually fuse into a series of upright bands. The abdomen is immaculate yellow. Total length, $4\frac{3}{4}$ inches; length of tail, $2\frac{7}{8}$ inches.

Range: The Central States, and inland portions of the Atlantic States.

Local Distribution: Mr. W. D. W. Miller has captured specimens near Plainfield, New Jersey. The writer has not taken it within the limits embraced by this work, but has found it abundant in Pennsylvania.



FIG. 10. THE LONG-TAILED, OR CAVE, SALAMANDER
From specimen in Am. Mus. Nat. Hist.

This vividly marked species is at times found at a considerable distance from water, though always in damp situations—in caves or among the fissures of moss-covered rocks. The writer took large numbers of specimens along a mountain stream, at the Delaware Water Gap, Pennsylvania. They were hiding under flat stones in the bed of a nearly dry stream. Their rich coloration was in strong contrast to the damp sand. About a dozen of these specimens lived for a period of more than two years in damp, *sphagnum* moss, placed in an vivarium. During

this period they were supplied with ant-larvæ and white ants, or termites. During the day they always remained hidden, but at night they were frequently observed crawling about the surface of the moss.

The Red Salamander, *Spelerpes ruber* Daudin (Fig. 11), is of moderate size. Its form is cylindrical, — slender when young, becoming stout with an increase in length. Limbs small; tail rounded at base and becoming flattened towards the tip. Rich red or salmon color above, profusely sprinkled with small black spots; paler beneath.



FIG. 11. THE RED SALAMANDER
From specimen in New York Zoölogical Park

Young specimens are frequently of a bright coral-red and not distinctly spotted. Those of medium size are darker red, with intensely black spots, while old specimens are often brownish and spotted with gray. Total length of fully adult specimen, $5\frac{1}{2}$ inches; length of tail, $2\frac{1}{2}$ inches; diameter of body, $\frac{1}{2}$ inch.

Range: Canada to the Gulf of Mexico and westward to the Mississippi River.

Local Distribution: Moderately abundant in the Orange Mountains of New Jersey.

The eggs are deposited early in the spring in the deeper pools of brooks; the adults are semi-aquatic, living in the beds of clear and cold brooks under flat stones or in immediate proximity to the water, into which they quickly make their way when disturbed. They may be sometimes found hiding under the luxuriant moss that covers rocks adjacent to mountain streams, where their brilliant color is in vivid contrast to their surroundings.



FIG. 12. THE MOUNTAIN SALAMANDER
From specimen in New York Zoological Park

The Mountain Salamander, *Desmognathus ocrophea* Cope (Fig. 12), is of moderate size. Body cylindrical; tail rounded for the greater part of its length, flattened near the tip and tapering to a long, sharp point. A wide band of brown extends down the back from behind the head to the base of the tail, where it narrows and becomes indistinct towards the tip. Beneath the brown band the sides are dark gray. From the eye to the angle of the mouth there is a band of light color. The abdomen is dirty white, and generally sprinkled with pure white dots.

Mountain
Salamander.

On occasional specimens the back is sprinkled with a line of black dots, giving the species a very similar pattern to the Two-

lined Salamander, which it also resembles in outlines. The adult Mountain Salamander may be recognized, however, by its rounded tail. Young specimens strongly resemble the Red-backed Salamander, even to the rounded tail. The following characters should be considered in separating them:

<i>Desmognathus ocropæa</i> . ¹	<i>Plethodon cinereus erythronotus</i> .
Form moderately slender.	Form very slender.
Stripe down the back brownish.	Stripe down the back reddish.
A light band from eye to angle of mouth.	No band from eye to angle of mouth.

Total length, $3\frac{1}{2}$ inches; length of tail, $1\frac{5}{8}$ inches; diameter of body, $\frac{5}{16}$ inch.

Range: Common in the Adirondacks and the mountains of northern Pennsylvania, whence it extends southward into the mountain chains of Virginia and North Carolina.

Local Distribution: Very rare, and the species may possibly not occur within the limits given. A single specimen has been taken at Greenwood Lake, N. J.² It has also been found in Allegany County, N. Y. It may occur in the Orange Mountains of New Jersey.

In habits it appears to be quite terrestrial, living under decaying logs or burrowing its way under their bark.

The Dusky Salamander, *Desmognathus fusca* Rafinesque (Fig. 13), is of medium size. The body is cylindrical and moderately slender; tail flat. Color above dark brown or gray, with an obscure, reddish brown tinge on the back. The reddish brown tone is usually distinct on the tail, where it is paler in hue. Numerous black spots show through the brown of the back, which is often bordered with a tinge approaching pink or flesh color, the pink also showing on the tail. Outside this pinkish shade are numerous minute white dots arranged in thick clusters on the sides of the body. The skin of the abdomen is light and translucent and finely marbled with gray. Very old specimens are generally so dark as to

¹ This species is of doubtful or very rare occurrence in this vicinity.

² Taken by Eugene Smith, of Hoboken, N. J.

appear almost uniform black above and show no traces of markings except on the sides and abdomen. The head is about the same width as the body. The front pair of limbs is feeble; the hind pair, larger and stronger. Total length, $4\frac{3}{4}$ inches; length of tail, $2\frac{1}{4}$ inches; diameter of body, $\frac{3}{8}$ inch.

Range: Eastern North America.

Local Distribution: Abundant in the vicinity of small streams.

This is the most abundant of our salamanders, but it is not



FIG. 13. THE DUSKY SALAMANDER
From specimen in New York Zoological Park

found except in the immediate vicinity of water. It is common in all situations where flat stones, dead leaves or similar objects not actually in the water, but in damp or muddy places in the beds of pools, offer concealment. When discovered in its lairs it runs and wriggles with bewildering agility, often taking to shallow water and secreting itself in the mud in order to escape. According to Cope, the eggs of this species are connected by an albuminous thread, which contracts and hardens after deposition. One of the sexes protects this string of eggs by twisting it about the body and remaining in concealment. The exact duration of the guard over the progeny is not definitely known. The young

salamanders emerge from the eggs with traces of external gills, which are soon absorbed.

The Water Newt, *Diemyctylus viridescens* Rafinesque (Fig. 14), is of medium size. The body is rather stout; the tail very flat and fin-like. Dark olive or green above, on which are scattered numerous small black dots; on each side of the back is a row of small round spots of brilliant vermilion or brick red and bordered with narrow rings of black. The abdomen and lower sides of the body are pale yellow, which

Water
Newt.



FIG. 14. THE WATER NEWT
From specimen in Am. Mus. Nat. Hist.

meets in abrupt contrast the olive of the upper surface; this pale color is thickly covered with small black dots. On the head the line of meeting of the dark and light colors is slightly below the center of the eye.

The tail is very thin and at all times shows traces of fin-like edges, this character being particularly noticeable with the males during the autumn and the spring. Compared with the size of the body the limbs are large and well developed. Male specimens may be distinguished from the females by the large and stocky appearance of the hind limb, the lower joint of which is flattened and very wide, and in appearance quite out of

proportion to the front limb. In female specimens the front and hind limbs are of nearly equal size. During the autumn the males acquire a peculiar series of hard ridges along the inner surface of the hind limbs. This growth is more pronounced during the breeding season when it is clearly discernible as a raised, black process of skin, with a rough surface like the angular edge of a file. Total length, $3\frac{3}{4}$ inches; length of tail, $2\frac{1}{4}$ inches.

Range: Eastern United States and southern Canada.

Local Distribution: General, in ponds and lakes.

In this immediate vicinity, the Water Newt is a strictly aquatic creature, unless, on account of unusual summer heat, the waters of its pond evaporate, when it takes shelter under stones or pieces of bark and in such damp places awaits the refilling of its pond by the fall rains.

The species breeds in the early spring, depositing the eggs singly or in pairs. The eggs are covered with a glutinous envelope and are deposited in such a manner that they adhere to the leaves of aquatic plants. The larvæ possess branching gills like those of the larvæ of the true salamanders. These gills often persist until the animals have reached a length of three inches or more, although absorption usually occurs when the larva is about two inches in length. Thus the transformation appears to be irregular, and not infrequently perfectly developed Water Newts are found that are barely one and one-half inches in length. The metamorphosis is undoubtedly hastened by the warmth of shallow ponds. After the gills have disappeared, the matured individual continues to lead an aquatic life, although if forcibly removed from the water and kept in a damp place, it will live for an indefinite time, breathing with a rapid trembling of the throat, which is the same as the respiratory gulping of the frogs.

The Red Eft, or Mountain "Lizard," *Diemyctylus viridescens miniatus* Raf. (Fig. 15), is a Water Newt which has deserted the ponds in mountainous districts and has taken up life in the damp woods. It is not, however, a distinct variety, since its terrestrial existence is irregular, and it frequently returns to the water to lead an aquatic life. The Red

Red Eft, or
Mountain
"Lizard."

Eft is merely a phase of the common Newt, but it is an interesting case of adaptation to environment.

Few observers who have visited mountainous places in the eastern United States have failed to notice in the damp woods the brilliant red "lizards" slowly making their way over the carpet of fallen leaves. Among residents of the country places they are known as Red Efts, Fire "Lizards" and Rain "Lizards." These are not lizards, but they are batrachians, and they represent a form of the common Newt that has seemingly tired of the water and begun a terrestrial existence. The animals vary in color from dull brown to brilliant vermillion. Rows of red dots



FIG. 15. THE RED EFT, OR MOUNTAIN "LIZARD"

From specimen in New York Zoölogical Park

are very apparent on the brown forms, while on the vermillion forms they are less distinct, but can be discerned as richer red, bordered with narrow circles of black. The brown specimens are forms that have left the water but a short time; those of the brilliant red hues have for some time been leading a terrestrial life. During dry weather the Red Efts hide under leaves and moss; after the summer showers they issue from their hiding-places to swarm through the woods.

In mountain ponds in the heart of districts where the red form is very abundant, the aquatic adults may be found swarming in the water. If the latter are taken from the water and kept in damp moss or among leaves, they lose their greenish tints and the smooth appearance of the skin, becoming dull brown and

rough, an indication of the red hue and rough skin of the terrestrial form. If, on the other hand, specimens found in the woods be placed in an aquarium, they at first show signs of marked distaste for their new quarters. After a time, however, they become reconciled to the water and lose their bright tints, thus beginning to assume the colors of their aquatic associates, while the tail grows broader and better suited for swimming. Very small, bright red forms are often found in the woods, demonstrating that such specimens have left the water immediately after completing the larval stage.

As an explanation of the eccentricities of this species it may be explained that the cool depths of the mountain forests, continuously and heavily shaded, and well saturated with moisture, offer the species an inducement to vary its life history. Close to New York City, where the red form is unknown, the writer has observed an intimation of this terrestrial tendency. In the thick woods of the Palisades of the Hudson, he has found occasional Newts hiding under pieces of bark that rested a few feet from the edge of a pool inhabited by numbers of the kind. Such specimens showed a tinge of brown like the form *miniatus*.

The terrestrial form has been described as possessing a much rougher skin and lacking the fin-folds of the tail of the aquatic form. These characters, however, are caused merely by the drying of the skin.

In the aquarium, the water form is an interesting creature, and may be kept in flourishing condition by feeding it small earthworms or small pieces of raw beef. The red form lives well in a vivarium which has been plentifully supplied with damp moss. It will eat the larvæ of ants and small earthworms. It may be found in the Highlands of the Hudson River. Its range of distribution is much the same as the water form, except that it occurs principally in mountainous districts.

TOADS AND FROGS.

Order *Salientia*.

The Toads and Frogs are the most familiar forms of the batrachians. Eleven species occur in the local fauna, representing four families. All of the local species deposit their eggs in the water and the young pass through a tadpole stage before acquiring the form of the adult. The duration of this larval stage varies considerably with the different species. In some it is limited to a few weeks, others require considerably more than a year to complete their metamorphosis. The growth in the water is much influenced by light and temperature.

For a short time after hatching, the tadpoles of most species are provided on the under surface of the head with two suckers. These organs enable the fragile creatures to cling to the leaves of aquatic plants instead of lying upon the muddy bottom, where they would be exposed to the attacks of many enemies in the shape of the carnivorous larvæ of aquatic insects. At the time of hatching, the young creatures are leech-like in appearance. Development is rapid. Within three days they present the complete form of the tadpole, with fin-like tail. Within a few hours after hatching the mouth-parts begin to develop, and a few days later the little creature feeds upon delicate aquatic vegetation. They then swim readily in search of food, and the suckers become aborted and quickly disappear.

For a few hours after leaving the egg, the frog tadpole possesses branching gills. These soon shrivel and their bases are covered with folds of skin (the "operculum"). Under this fold the fore limbs soon begin their growth. This is the first pair of limbs to acquire full growth, but they are not visible until after the hind pair has appeared. From external appearances the frog tadpole thus seems to acquire the posterior pair of limbs first. Somewhat later the front pair suddenly are thrust through the

folds of the operculum. This is in contrast with the larvæ of the salamanders, in which the operculum is absent and the fore limbs are nearly full grown before the rear pair is visible. Moreover, the tadpoles of the salamanders retain their gill-stalks on each side of the head until after the growth of the limbs is completed.

A popular key to the identification and classification of the Toads and Frogs follows:

Key to the Toads and Frogs.

- I. Tips of toes (digits) expanded in the form of adhesive disks or "suckers"..... **The Tree Toads.**
 - a. SIZE VERY SMALL.
 1. *Disks but slightly developed.*
Brown; a wide green band on the back..... **Cricket Frog** (*Acris gryllus crepitans*).
Gray; three brown bands on the back..... **Swamp Tree Toad** (*Chorophilus triseriatus*).
 2. *Disks well developed.*
Brown to green (varying); a dark, X-shaped mark on the back..... **Pickering's Tree Toad** (*Hyla pickeringi*).
 - b. SIZE SMALL.
Bright green above, which hue is bordered on sides with a band of white. A purplish band from behind nostril.... **Anderson's Tree Toad** (*Hyla andersoni*).
Grayish, with wavy, irregular markings..... **Gray Tree Toad** (*Hyla versicolor*).
- II. No digital disks. Size moderate to large..... **The Toads and Frogs.**
 - a. SIZE MODERATE.
 1. Skin thickly studded with wart-like tubercles; a large gland behind the eye..... **The Toads.**
Pupil of eye horizontal..... **Common Toad** (*Bufo lentiginosus americanus*).
Pupil vertical..... **Spade-foot Toad** (*Scaphiopus holbrooki*).

2. Skin smooth; no gland behind eye **The Frogs.**
- 2a. A vein-like fold of skin from behind eye to the groin.
 Pale brown; a dark-brown blotch behind the eye **Wood Frog** (*Rana sylvatica*).
 Olive, with large, round, black spots, irregularly scattered... **Salt-marsh Frog** (*Rana virescens*).
 Pale brown, with four rows of large black spots **Leopard Frog** (*Rana palustris*).
 Green or olive; head paler.... **Pond Frog** (*Rana clamitans*).
- 2b. No vein-like fold of skin.
- b. SIZE LARGE.
 Olive, irregularly mottled with brown **Bull Frog** (*Rana catesbiana*).

DESCRIPTIVE LIST OF THE TOADS AND FROGS.

The Common Toad, *Bufo lentiginosus americanus* Le Conte (Fig. 16), is of moderate size and stout form. The skin is very rough. A large and prominent gland exists behind the eye. Color above brownish or yellowish brown, with numerous large dark spots, narrowly, though distinctly, edged with pale yellow. Extending down the center of the back is a pale yellowish or whitish band. The abdomen is dirty white. The ground color varies in individuals, some being distinctly reddish, and is influenced by temperature and changes on the individual itself from a lighter to a darker shade or the reverse. The pupil of the eye is horizontal.

The Toad is a familiar creature and is quite characteristic in appearance on account of its very rough glandular skin and the large, swollen glands behind the eyes. The hind feet are but slightly webbed. The blackish hue of the skin under the throat of the male Toad distinguishes it from the female. This skin is capable of great extension as the creature gives voice to the peculiar cry of the breeding season. The females are larger than the males. Length of body of male specimen, $2\frac{2}{3}$ inches; of female, $2\frac{3}{4}$ inches.

Range: Four varieties of this species inhabit North America. One of these appears to occur only in northeastern Massachusetts; another is confined to the Rocky Mountain region; the typical form is found in the southeastern United States, while the variety that occurs locally is distributed over an extensive area, namely: from British America to the Southern States and westward to Arizona.

Local Distribution: Common and abundant.

There is but one species of the local batrachians which



FIG. 16. THE COMMON TOAD
From specimen in Am. Mus. Nat. Hist.

might be confused by the observer with the Common Toad, and that is the Spadefoot Toad. The Spadefoot Toad receives its name from a pronounced spade-like process on the inner edge of the hind foot, a feature which is also slightly developed on the common species. The color of the Spadefoot is, however, quite different from the ordinary toad. Instead of the single light band along the back of the Common Toad, the Spadefoot has two pale bands, which run together and fork at the end of the body.

Many of the reptiles and batrachians have habits which render them of considerable economic value to the agriculturist,

but the Toad ranks first in the list of useful species. Although mainly insectivorous, the depredation on insect life made by the frogs is chiefly confined to the borders of ponds and streams, or to the marshes; in fact, to places not available for agriculture. The Toad, on the contrary, is a terrestrial species, inhabiting the open country and abounding over stretches of farmland. Here at twilight multitudes of toads issue forth to prey upon all forms of insect life, continuing the hunt throughout the night, and retiring at dawn for digestion. The examination of a toad's stomach after a nocturnal excursion will reveal an amazing number of insect forms, among which may always be found species that are destructive to agricultural products.

Among the writings of Shakespeare there are allusions to the venomous character of the Toad which have inspired innumerable scientists to clash in argument. Comparatively recent anatomical investigations have resulted in the discovery that a milky secretion contained in the swollen glands situated behind the eyes and in minute glands scattered over the surface of the skin possesses decidedly poisonous properties. When this fluid is injected into the blood of small mammals, marked symptoms at once develop and speedy death follows. The symptoms produced have been described as similar to those due to the use of *digitalis*, the action being upon the nerve centers and the heart. The effect upon any unwary dog that seizes a toad in its jaws is at once evident. There are immediate signs of distress, and the animal soon foams at the mouth and champs its jaws as if in considerable pain. These symptoms continue for an hour or more.

When the larger glands on the head are compressed, tiny jets of a sticky white fluid are ejected to a distance of three or four inches. Through accident the writer has discovered that this fluid is intensely bitter to the taste. In spite of this poisonous secretion, the Toad is generally harmless when handled. The story of wart-producing powers, furthermore, is purely fallacious. The secretion in the glands which have been mentioned is dangerous only when injected directly into the blood of small animals, but nevertheless Shakespeare's much-combated references have been proved to have abundant foundation in fact.

Most batrachians, particularly those species with a rough skin, secrete a certain amount of this irritant.¹

The Toad is protected by the characters just mentioned from attack by most mammals and birds. The species of snakes, however, that prey upon cold-blooded creatures, appear to prefer toads to frogs.

In its metamorphosis the Toad differs somewhat from the frogs. It leaves its place of hibernation rather late, not until warm weather has become established in the spring, when the weird, drawn-out trill of the males is heard about rain pools and shallow bodies of still water. The eggs are deposited in long strings.² After the strings have absorbed the required amount of water through their transparent covering and lie upon the bottom undergoing development. Each egg measures about a quarter of an inch in diameter. The tadpoles emerge from the eggs after a period of eight to ten days from deposition. They resemble minute leeches and cling for some hours to the leaves of aquatic plants by means of small suckers on the lower surface of the head. Within forty-eight hours they cease the clinging stage and wriggle their way about by means of a rapidly developing, fin-like tail. Four days after hatching they are agile swimmers and feed upon mossy growths of the pool.

The writer has made the following observations upon growth during the tadpole stage:

May	3.	Tadpoles hatched. Clinging stage.....	Length,	$\frac{1}{8}$ inch
"	4.	Body more elongate; swimming feebly at frequent intervals.....	"	$\frac{3}{16}$ "
"	5.	Tail distinctly compressed.....	"	$\frac{1}{4}$ "
"	6.	Tail shows fin-like edges.....	"	$\frac{9}{32}$ "
"	7.	Tail fully developed; feeding.....	"	$\frac{5}{16}$ "
"	12.	Body assuming stout proportions.....	"	$\frac{1}{2}$ "
"	17.	Color above jet black.....	"	$\frac{3}{4}$ "
"	25.	Tadpoles appear fully grown and cluster in masses in very shallow places.....	"	$1\frac{1}{16}$ inches

¹ Among the local frogs the character named is strongly evidenced by the Leopard Frog (*Rana palustris*). When handled, this species gives out a strong odor. Few snakes will eat it.

² The eggs of the frogs are deposited in masses.

- May 26. Rudiments of hind limbs discernible.
- " 30. Hind limbs perfectly formed in miniature and measure $\frac{3}{16}$ inch in length. The tadpoles are now brownish and show traces of spots. Length $1\frac{5}{32}$ inches
- June 4. Hind limbs $\frac{3}{8}$ inch long.
- " 5. " " $\frac{7}{16}$ " "
- " 12. " " fully developed. " $1\frac{1}{4}$ "
- " 14. Front limbs break through operculum.
- " 16. Absorption of tail rapidly taking place.
- " 18. Tail nearly absorbed; young toads leaving the water.
- " 20. Metamorphosis complete; surrounding meadows teeming with perfectly developed toads measuring $\frac{7}{16}$ inch (body).

The full-grown tadpole of the Toad and the perfectly developed creature as it leaves the water, are much smaller than the frog tadpole, which usually attains a length of three and one quarter inches before growth of the hind limbs begins, while the perfect frog generally measures an inch or more when it becomes fitted for semi-aquatic life. The tiny toads fall a prey to many enemies, and but a small proportion of their numbers attains maturity. Full growth is reached in about three years.

The Spadefoot Toad, *Scaphiopus holbrookii* Harlan (Fig. 17), is moderate in size. In form it is very stout, with wide, blunt head. Color, dark brown, or ashy-brown, with two rather indistinct bands of paler shade on the back; these bands begin behind the eyes and extend in wavy or irregular fashion to the end of the body, where they run together.

Although the skin is rough and is covered with numerous raised points, it presents a smoother surface than that of the Common Toad. The parotid gland (behind the eye), though well-developed and very pronounced, is of smaller size in proportion to the individual than that of the Common Toad.

On the inner portion of the under surface of the hind foot there is a hard, spade-like process, tinged at the edge with deep black. From this appendage the creature derives its name. The hind foot is fully webbed. The pupil of the eye is elliptical

(cat-like), a characteristic which is useful in distinguishing this species from the Common Toad, since in the latter the pupil is horizontal.

The species presents some variation in color pattern. Specimens from the northern portions of the United States are sometimes nearly uniform in color, while those from the extreme South possess a very distinct pattern. Length of body, in sitting posture, $2\frac{1}{2}$ inches; total length, hind limbs outstretched, 5 inches; width of head over ear plates $1\frac{1}{2}$ inches.

Range: The entire eastern United States, from New England to Florida and westward to Texas.



FIG. 17. THE SPADEFOOT TOAD
From specimen in New York Zoological Park

Local Distribution: Rare.

The retiring habits of the Spadefoot Toad render it an object seldom seen. The animal employs the sharp scoops of its hind feet to work its way into the soft ground or sand, and there passes the hours of daylight entirely hidden. At night or after heavy showers it ventures abroad for food, sometimes lingering in the vicinity of a rain-pool and uttering its plaintive cry. During the latter part of April and in May this toad congregates in numbers about shallow bodies of water to breed. The voice of the male resembles the tremulous call of the Common Toad, but is slightly louder. The eggs are similar to those of the Toad, and are laid in strings. The metamorphosis is completed within a few weeks from the time of hatching.

The Cricket Frog, *Acris gryllus crepitans* Baird (Fig. 18), is very small. The skin is rough. The body color is brown or grayish brown. Extending from the snout nearly to the end of the body there is a wide band of bright green, which is interrupted between the eyes by a dark triangular blotch, with its point directed backwards. There are three small blotches on the sides, while the hind limbs are banded with dark brown. Beneath, the color is yellowish white.

Cricket
Frog.

This species is subject to rapid and marked color changes

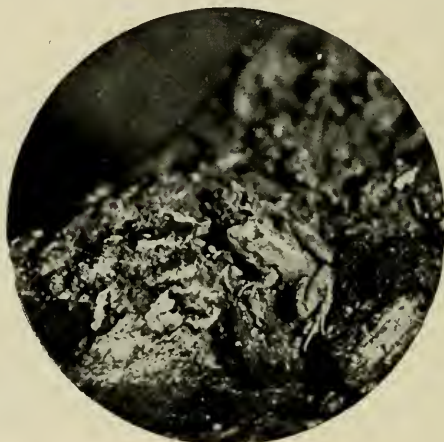


FIG. 18. THE CRICKET FROG
From specimen in New York Zoölogical Park

under the influence of varying temperature and the mood of the individual. These changes affect the general color of the body and the bright band down the back. The band, although usually of some shade of green, sometimes fades to yellowish brown. The species is easily distinguished on account of its distinct color pattern. It is the smallest of the local, tailless batrachians. Length of body, $\frac{7}{8}$ inch; total length with hind limbs outstretched, $2\frac{1}{4}$ inches.

Range: The typical form occurs from North Carolina to Florida, and westward to Louisiana. The variety *crepitans*, also, is found from the southern portion of New York State to North Carolina; it extends westward to Kansas, and still farther westward in the extreme northern portion of its range.

Local Distribution: The local form, var. *crepitans*, is common in portions of Long Island and in New Jersey.

The Cricket Frog frequents the borders of shallow pools, where its sharp, trilling cry, resembling in volume the call of the field cricket, may be heard at various times of the year. It is particularly vociferous during the breeding season. The eggs are deposited early in May in small bunches. They usually adhere to grass or reeds.

The animal is very difficult to capture, since it possesses



FIG. 19. SWAMP TREE TOAD
From specimen in Am. Mus. Nat. Hist.

great leaping powers and quickness in diving. During periods of heavy dew these frogs may be found in high grass adjacent to marshes. Owing to its smallness and agility, it is rarely observed after the breeding season.

The Swamp Tree Toad, *Chorophilus triseriatus* Wied. (Fig. 19), although a very small species, is larger than the Cricket Frog. It may be readily recognized by the coloration. The ground color is pale gray. On the back are three dark brown stripes or bands, extending the length of the body. On the side is a broader band, extending from the snout

Swamp
Tree Toad.

across the eye and thence along the greater length of the body. The abdomen is whitish, with a few scattered black dots. Length of body, $1\frac{1}{16}$ inches; total length, with hind limbs outstretched, $2\frac{1}{4}$ inches.

Range: This is essentially a western species. It is very abundant in the northwestern portion of the United States, east of the Rocky Mountains, whence it extends southward into Texas. The range extends eastward in the shape of a narrowing band which terminates in central and southern New Jersey. In this apex of its eastern distribution the species is common, especially in the swampy areas of the barrens of the southwestern part of the State.

Local Distribution: Mr. W. D. W. Miller has taken many specimens near Plainfield, N. J.

Like other species of the *Hylidæ*, this creature leaves its winter quarters early and gathers about shallow pools and ditches to breed. It is not an agile swimmer, since the hind feet are not webbed. If alarmed when near the water, it wriggles its way into the marginal vegetation so quickly that it is difficult to capture. Its cry is a sharp trill like that of the Cricket Frog.

Pickering's Tree Toad, or "Peeper," *Hyla pickeringi* Storer (Fig. 20), is a very small animal. The body is pale brown above with distinct, narrow markings on the back which assume the form of an X on the upper portion of the back, behind which is a \wedge -shaped marking. At the end of the body there is another mark, similar to the latter, but of about half the size. A similar mark with the point directed backwards occurs behind the eyes. A band of the same dark color that constitutes the markings on the back extends from the snout across the eye, and thence down the side to a short distance behind the fore limb. The hind limbs are banded. Beneath, the color is yellowish white.

Although the color-pattern is generally pronounced, and the usual colors of the species are as described, this individual varies greatly in color, not only in different individuals but also in the same individual at different times. The writer has observed specimens of normal colors change to pale gray, and

others to a bright tint of green. While the animal was in the green phase, the pattern on the back could not be discerned.

The toes are provided with well-developed adhesive disks, or "suckers," which are particularly distinct on the fore feet. The skin of the abdomen is coarse and granulated; that of the back is smooth.

Male specimens of this species may be distinguished from the females by the loose, dark skin on the throat. This loose skin constitutes the vocal sac, an organ capable of great ex-



FIG. 20. PICKERING'S TREE TOAD
From specimen in New York Zoölogical Park

pansion while the animal is uttering its shrill mating call. Length of body, $1\frac{1}{8}$ inches; total length, hind limbs outstretched, $2\frac{1}{2}$ inches.

Range: The entire eastern and central portions of the United States, abundant.

Local Distribution: Common, but not easily seen.

Only three representatives of the genus *Hyla* are found in this vicinity.¹ The species are easily distinguished from one another by their characteristic color-patterns, and from other tailless batrachians by their peculiar feet and the disks on the toes.

¹ One species, the *Hyla andersoni*, is of doubtful occurrence, although it is included in this Leaflet.

With the first mild days of spring, the bogs and marshes resound with the cheery, piping notes of the males of this species, the peculiar character of which has given rise to the popular name of "Peeper." Specimens are difficult to find, since they hide among the blades of the coarse grass, and when disturbed take refuge in the water. After the breeding season the animals



Miss Mary Dickerson, Photo.

FIG. 21. ANDERSON'S TREE TOAD

leave the bogs and live among the leaves and low bushes and rank vegetation, and their sharp cries are seldom heard. To produce the piping cry, so intense and penetrating for so small a creature, the male fills his vocal sac with air until it is more than half the size of the body. Then the air is expelled with such energy that the sides of the tiny creature become hollow with the convulsive effort. The eggs of this species are deposited in small masses and hatch quickly. The tadpoles undergo a rapid metamorphosis.

Anderson's Tree Toad, *Hyla andersoni* Baird (Fig. 21), is of moderate size. The disks on the toes are well developed. Bright pea-green above with a narrow, though very distinct, white border on the sides and upper surfaces of the limbs. A narrow, purplish brown band extends from behind each nostril, across the eye and to the base of the fore limb. The lower sides are purplish brown, though of a lighter shade than the band, and are ornamented with irregular spots of a lighter and richer hue. The abdomen is pinkish white, though its edges are suffused with the purple tinge of the sides.

Anderson's
Tree Toad.

This species is of great rarity, and but very few specimens have ever been captured. It is a most attractively colored creature, and on account of the pale green of the upper surface resembles the European Tree Toad. Mature specimens are from an inch and a quarter to an inch and a half in length.

Range: The species is so rare that its range has not yet been determined, but is supposed to extend from southern New York to Florida. The species has been found in South Carolina.

Local Distribution: One specimen has been taken at Jackson, N. J., another at May's Landing and still another (represented in the figure) at Lakehurst, in the same State.

The Gray Tree Toad, *Hyla versicolor* Le Conte (Figs. 22 and 28), is of moderate size and stout form. The ends of the toes are disk-like and adhesive. Color above, usually pale lichen-gray, with large wavy and irregular markings of darker shade. On the hind limbs these darker markings are so disposed that they appear to form two bands when the limbs are folded. Abdomen uniform grayish white; lower portion of hind limbs tinged with bright yellow.

Gray Tree
Toad.

The skin is very rough and is covered with minute, warty points on the back. Male specimens differ from the females in having loose, dark skin under the throat.

The species exhibits great variation in color according to light, temperature and the temperament of the individual. From the pale, ashy gray ordinarily present, the color varies to brown, very dark gray, or to vivid green. With the variation

of color the pattern becomes obscure or more prominent. Length of body, 2 inches; total length with hind limbs outstretched, $4\frac{5}{8}$ inches.

Range: The entire eastern and central portions of the United States, from Maine to Florida, and westward to Texas.

Local Distribution: General and fairly abundant.

The call of the Gray Tree Toad is a loud clattering sound, and resembles the scolding of a frightened chipmunk or red squirrel. It is said that the Tree Toad is particularly vociferous before a coming rain. Like other prognosticators of the weather, however, these creatures are quite unreliable. Their cries are



FIG. 22. THE GRAY TREE TOAD
From specimen in New York Zoölogical Park

particularly frequent during the sultry intervals that follow a light summer shower. After the breeding season is over, this Tree Toad frequents trees and usually takes up its abode at some elevation above the ground. It is supposed to deposit its eggs during the latter part of May or early in June. Small weedy ponds are usually selected as breeding-places. The eggs hatch quickly and the transformation from the tadpole stage is rapid.

The Salt-Marsh Frog, *Rana virescens* Kalm (Fig. 23), is of moderate size and rather slender form. Ground color bronze to olive or bright green, but always vividly marked with large and irregularly scattered round spots of dark brown or black; on the back several of these spots are very elongate. The spots are more regularly disposed on the hind limbs, and when the legs are flexed, they have a banded

Salt-Marsh
Frog.

appearance. Over each eye there is a rounded spot, placed slightly inwards towards the center of the head.

A raised, vein-like fold of skin extends from behind each eye to the end of the body and is pale bronze in color. A stripe of similar color extends on each side of the head from the tip of the snout to behind the earplate, where it terminates in a raised skin fold. The under parts are white, indistinctly mottled with gray about the limbs.

When examined from directly above, the arrangement of the spots on the back appears to be irregular. This character may be employed to distinguish the species from the Leopard Frog,



FIG. 23. THE SALT-MARSH FROG
From specimen in New York Zoölogical Park

which it resembles in form and pattern. On the Leopard Frog the spots are rather square in shape and are quite regularly disposed in rows down the back and the sides. Length of body, $3\frac{1}{2}$ inches; total length, hind limbs outstretched, 9 inches. These measurements were taken from a very large specimen. The average length of body is about $2\frac{3}{4}$ inches, and total length more than 7 inches.

Range: Maine to Texas. Several varieties of the species are recognized, some of which occur in the Western States, Mexico and Central America.

Local Distribution: Abundant in swampy situations near the coast.

The Salt-Marsh Frog, sometimes called the Field Frog, inhabits swampy meadows rather than large bodies of water, and is common in many brackish swamps in this vicinity, although it is also found in fresh-water swamps. It is particularly abundant in the Newark meadows. The vocal sacs of the males are



FIG. 24. THE LEOPARD FROG, OR PICKEREL FROG
From specimen in Am. Mus. Nat. Hist.

very prominent externally and become distended as the species gives voice to its sharp, rasping call.

The Leopard Frog, or Pickerel Frog, *Rana palustris* Le Conte (Fig. 24), is of moderate size and rather slender form. Ground color above, pale brown, with four rows of large square spots, two rows down the back and one on each side. These spots are very dark brown or black. The hind limbs are banded with the same color, which is also present in irregular spots on the fore limbs. There is a large spot over each eye, and one directly over the snout. The upper lips are dark brown, and above this color there is a band of pale bronze.

Four ridges or elevated folds of the skin extend down the back, the two outer rows of which are vividly tinged with light bronze; the two inner folds traverse the centers of the rows of dark spots on the back. The abdomen is silvery white. The under surface of the hind limbs is bright yellow, as is also a small area behind each fore limb.

The species may be distinguished from the Salt-Marsh Frog by the regularity of the rows of spots. It is the most showy of our local frogs.

Range: Eastern North America.

Local Distribution: General.

The Leopard Frog is a wanderer, traversing and frequenting stretches of damp meadows and fresh-water swamps. It is sometimes found a considerable distance from the water. Young specimens are most numerous about shallow, slow-running streams bordered with dense vegetation.

When in danger this frog exudes through its skin an acrid secretion which protects the creature from its enemies. Few snakes eat these frogs. They are said, however, to be good bait for pickerel on account of their bright colors; hence one of the popular names, the "Pickerel Frog."

The Pond Frog, or Green Frog, *Rana clamata* Daubin (Fig. 25), is a large species. Form, stout. Dark brown or olive-green above, with an irregular sprinkling of darker spots; head usually bright green. White beneath, with an obscure marbling of gray about the under surface of the limbs; throat of the male generally yellow; of the female, white, marbled with gray.

Pond, or
Green,
Frog.

The color of the individual varies with the changes in light and temperature. A common phase displays much vivid green about the head and anterior portion of the body, while the posterior portion is brown or olive. Sometimes the entire body is green, in other instances dull brown. The male may be distinguished from the female by his much larger earplate (tympanum).

This species resembles the Bull Frog, but may be readily distinguished therefrom by a marked anatomical character: on each side, beginning behind the eye and extending nearly the

entire length of the body, there is a vein-like ridge or fold of skin. The Pond Frog is, moreover, considerably smaller. Average length of body, $3\frac{1}{2}$ inches; total length, with limbs outstretched, $7\frac{3}{4}$ inches.

Range: Eastern and central United States and southern Canada.

Local Distribution: General and abundant.

With the possible exception of the Toad, the Pond Frog is the most familiar of our local batrachians. It is found everywhere and abundantly in ponds and streams, where its familiar



FIG. 25. THE POND FROG, OR GREEN FROG

From specimen in Am. Mus. Nat. Hist.

croaking may be heard during the summer months. The eggs are deposited in masses early in the spring. The jelly-like clusters containing the numerous black dots representing the developing embryos are familiar objects. The tadpoles are rather slow in growth, generally consuming two seasons before they complete their metamorphosis, according to the temperature of the water and its exposure to sunlight. In the fall the tadpoles burrow into the mud and hibernate. The average tadpole is three inches in length when the limbs are well advanced in growth, and the young frog, immediately after absorption of the tail, measures slightly more than an inch. Tadpoles

confined in indoor aquaria are much retarded in their growth, and many remain as such for a period of three years or more.

The Bull Frog, *Rana catesbiana* Shaw (Fig. 26), is very large and stout. Limbs short but powerful. Hind feet large and very fully webbed. Head wide. Color above, light olive, irregularly blotched or marbled with dark olive or brown. The intensity of these markings varies with individuals and the disposition of the individuals themselves. Limbs, especially the hind pair, with brown blotches which to-

Bull
Frog.



FIG. 26. THE BULL FROG
From specimen in New York Zoölogical Park

ward the extremities assume the form of bands. The under parts are silvery white, with grayish markings, the throat in many individuals assuming a yellowish tinge. The portion of the head between the mouth and the eyes is usually tinged with pale green; the upper surface, however, matches the general color of the body.

Half-grown specimens resemble the adult of the Pond Frog, but may be recognized by the absence of the vein-like fold of

skin which is present on each side of the body in that species. There is, in fact, no trace of this in the Bull Frog. A full-grown specimen will measure $14\frac{1}{2}$ inches from the tip of the snout to the end of the outstretched limbs, and $6\frac{3}{4}$ inches when in a sitting position. Such a specimen would weigh about one pound.

Range: The eastern and central portions of the United States and southern Canada.

Local Distribution: General, but not so abundant as the Pond Frog.

The Bull Frog frequents larger bodies of water than the common Pond Frog, being especially partial to large ponds and slow-running rivers, where the banks are lined with overhanging vegetation in which it can find concealment. The tadpoles grow to a greater size than those of the Common Frog. They may be distinguished by their distinctly yellowish abdomen. During the hours of sunlight they have a habit of lying in shallows around the borders of the pond, but upon the slightest disturbance they scurry for deeper water with startling activity and swim close to the bottom in order to leave a trail of muddy water, agitated by the thrashing of their tails. This maneuver tends to conceal their exact location.

Bull Frogs, particularly young specimens, have a peculiar habit of emitting a sharp cry when disturbed on the bank, and instead of plunging directly into the water, they skim over the surface for a short distance. The Common Frog, on the other hand, when disturbed, jumps into the water and instantly dives to the bottom, where, with a quick kicking of the hind limbs, it stirs up a cloud of mud in which it can conceal itself.

The Bull Frog is a most voracious creature. Mature specimens do not hesitate to swallow any moving object of about their own size that may come within reach of the wide gape of their jaws. They are largely insectivorous, but birds and small rodents are frequently eaten. Captive specimens experience no difficulty in swallowing sparrows or half-grown rats.

The call of a Bull Frog differs from the ordinary "croak" of a Pond Frog. It is a deep, protracted bass, resembling the sound made by drawing a bow for half its length across the string of a bass-viol. The note is repeated four to six times.

The eggs of the Bull Frog are laid in May. During the latter part of July or in August of their second summer the tadpoles acquire limbs and leave the water as perfect frogs.

The Wood Frog, *Rana sylvatica* Le Conte (Fig. 27), is of small size. It is light brown above, with a dark brown spot on each side of the head. This spot extends from the snout through the eye (darkening the lower half of the iris), covers the earplate and adjacent area and terminates in a sharp angular outline with a fold of the skin behind

Wood
Frog.



FIG. 27. THE WOOD FROG
From specimen in New York Zoölogical Park

the base of the fore limb. A whitish line in strong contrast with the dark color on the sides of the snout traverses the upper lip. There is a smaller dark spot near the base of the fore limb. The hind limbs are indistinctly banded on the upper surface. The abdomen is silvery white.

Two well-defined ridges, or vein-like folds, extend down the back of this easily-recognizable species. In different specimens the body color varies somewhat, some are distinctly reddish. The characteristic dark spot on each side of the head is always apparent, however, and facilitates identification. Length of body, $2\frac{1}{4}$ inches; total length, with hind limbs outstretched, $5\frac{3}{4}$ inches.

Range: Like many of the North American frogs, it is gener-

ally distributed over the eastern and central portions of the United States and southern Canada. It does not extend, however, into the sandy portions of the Southern States.

Local Distribution: The Wood Frog appears to be restricted to certain areas, in which it is abundant. The writer has found it common in the woods along the Palisades of the Hudson River and in Westchester County, N. Y.

The Wood Frog, even where it is abundant, is not often seen, on account of its habit of living among the fallen leaves of timbered districts and the fact that its sober colors almost precisely match the dead leaves. It is aquatic only in the spring, when it frequents small bodies of water for the purpose of laying its eggs. At such times the croaking of the many males indicate the first awakening of the cold-blooded creatures from their winter sleep, for the Wood Frog lays its eggs before the ice has entirely left the ponds. The writer has repeatedly observed them as early as March. The eggs are deposited in masses from two to three inches in diameter, and hatch within ten days. The tadpoles grow rapidly and, unless their pool receives the water from cold springs, complete their transformation early in the summer. They are black above and bright golden bronze beneath. Upon leaving the water the young frog is slightly more than half an inch in length.



FIG. 28. THE GRAY TREE TOAD
From specimen in New York Zoölogical Park

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