CHAPTER XVI

PHYLUM CHORDATA — PART III

SUB-PHYLUM VERTEBRATA. CLASS IV — REPTILIA

Characteristics. The word *reptile* is derived from the Latin verb "repere," meaning to *creep* or to *grovel*. The name applies not only to the *snakes* but to lizards, turtles, tortoises, crocodiles and alligators as well, for these are included in the class *Reptilia*. The body is covered with epidermal scales; the toes if present have claws; the gills are limited to the embryonic period while the respiratory organs of the young after *hatching* are lungs. Fertilization is internal; the eggs are few and of considerable size, resembling those of birds, with yolk, albumen and shell; development takes place outside the body of the mother, *i.e.*, reptiles are oviparous; the embryo develops rapidly, and at hatching the young break the shell. Reptiles are essentially land forms and are the first Vertebrates to take up permanent life upon the land.

Reptilia were once the dominant land Vertebrates. This was during the Mesozoic Era, a period estimated to have lasted for thousands of centuries. There were then many more types than at present, and primitive birds and mammals were just emerging. Some Mesozoic Reptilia attained gigantic size.

Anatomically, reptiles are similar in many respects to the amphibians; as, for example, in their circulatory systems and in limb structures. In other respects they are dissimilar; as, for example, reptiles possess radically modified excretory and reproductive systems. Birds and mammals retained certain features of the reptilian advance.

Amnion and Allantois. Embryonic respiration is carried on through a foetal sac called the *allantois* and the embryo is protected in a membranous sac called the *amnion*. (See page 348.) Reptiles, birds and mammals are alike in the possession of a foetal

amnion and have therefore been called *Amniota*, while fishes and amphibians are known as *Anamniota* since they lack it.

The Anamniota develop in water. However, this is also true in a way of the Amniota, for the amnion is filled with a watery fluid, so that, as Walter has observed, "*every Vertebrate passes its early life submerged in water.*"

FIG. 254. — Iguana tuberculata. (Amer. Mus. Nat. Hist.)

Classification

There are five groups of Reptilia living today.

Order 1. Rhyncocephalia. Many fossil forms are included in this order of which but one living species remains, namely, Sphenodon found in New Zealand. It is lizard-like in appearance and is unique in the possession of a third but degenerate "eye" in the roof of the skull. This form is so rare and of such great scientific interest that it is at present under governmental protection.

Order 2. Lacertilia. These are lizards. They have two pairs of legs and a tail. They are most numerous in warm countries, preferring a warm, sunny, dry habitat. The *Iguana* (Fig. 254) of tropical America is large and ferocious in appearance, but actually is otherwise and is used as food. *Phrynosoma*, from the dry lands of our southwest, is called the 'horned toad' but is not an amphibian. *Heloderma*, the Gila Monster (Fig. 255), is found in the same locality and is a large, brightly colored, sluggish and forbidding-looking lizard and said to be poisonous, which is not true of lizards as a class. Many lizards move swiftly when disturbed.

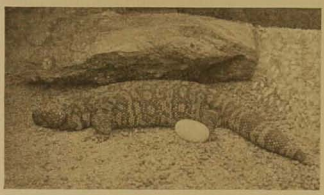

FIG. 255. — Heloderma — Gila Monster with its egg. (Amer. Mus. Nat. Hist.)

Order 3. Ophidia or Serpents. These forms have no limbs or limb girdles although some, such as the python, retain vestiges of the limb girdles. On the mid-ventral line anterior to the anus is a row of large scales to the inner ends of which are attached the outer ends of ribs. The outer edges of the scales act as fulcra of levers, of which the ribs are a part. The levers are operated by muscles of the body wall, forming organs of locomotion. The absence of limbs and the sinuous nature of the backbone enable snakes to glide through small passageways. They seem to 'flow' along the ground, and the rapid movement in the absence of apparent organs of locomotion startles most observers.

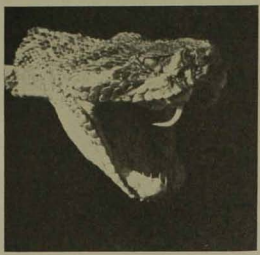

FIG. 256. — Head of rattlesnake showing 'poison' fang. (Amer. Mus. Nat. Hist.)

There is no ear drum and the sense of hearing is poor. The tongue is protrusible and is probably used to receive stimuli other than those of taste. Teeth are sharp and pointed backward to prevent prey from escaping. In poisonous snakes there are grooved teeth or the latter have ducts through which toxins from the poison glands are introduced into the blood stream of the victim (Fig. 256). The apparatus *works* like a hypodermic syringe. Many of the bones of the jaw apparatus are movable so that snakes can swallow comparatively large animals. The vibrating *rattle* of *Crotalus*, the North American Rattlesnake, warns the oncomer of danger ahead. There are a number of species of American rattlesnakes. However, but few of all types of American snakes are poisonous. On the whole,

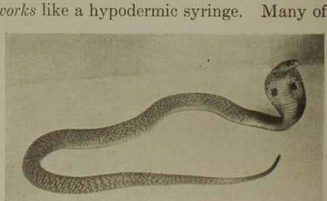

FIG. 257. — Naja — The cobra. Photo by N. Y. Zoological Park.

snakes are useful to man in destroying harmful insects and rodents. The Cobra (Fig. 257) of India, China and the Malay Archipelago is vicious and deadly. It causes the death of thousands of natives annually. Today the rapid development and wider use of anti venom sera for snake bite is saving many lives.

Fig. 258. — Malacoclemmys — Diamond-back terrapin. (Amer. Mus. Nat. Hist.)

Order 4. Chelonia. These are turtles, which are aquatic forms, and tortoises, which are land forms. They have an exoskeleton of horny epidermal shell which covers a deeper layer of bony plates. The soft parts are inclosed in a protective armor and only the limbs, tail, head and neck venture outside the shell when the animal is moving about. The diamond-back terrapin (Fig. 258) is highly prized as a food product, and successful *farming* experiments have been developed by the U. S. Bureau of Fisheries. The giant land tortoise *Testudo* (Fig. 259) of the Galapagos Islands lives to a great age and is a sort of *living fossil*. The giant form among the turtles is *Sphargis*, the leathery turtle found along the coasts of Florida and Brazil. Specimens weighing over a thousand pounds have been taken.

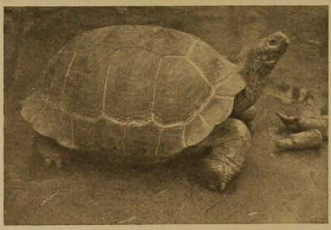

Fig. 259. — Testudo — Giant tortoise. (Amer. Mus. Nat. Hist.)

Order 5. Crocodilia. These are large reptiles, including crocodiles and alligators (Fig. 260). They live in and out of the water in or near the tropics. The nostrils are at the tip of the long snout and farther back are the protruding eyes, enabling the animal to remain in the water with the body immersed and almost invisible but on the watch for prey.

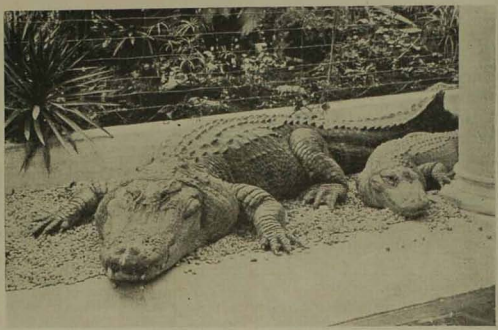

FIG. 260. — Alligator. Photo by N. Y. Zoological Park. Courtesy N. Y. Zoological Society.

Most reptiles have two distinct auricles and one ventricle, as have the amphibians. However, in reptiles there is a *perforated* partition dividing the ventricle into a right and left portion. This device serves fairly well to keep separate the oxygenated from the unoxygenated blood in the heart. In the Crocodilia the partition in the ventricle is more complete, so that they have a right and left ventricle, as have birds and mammals.

FIG. 261. — Oreortyx pictus — California quail.

CLASS V — AVES

Characteristics. Birds and mammals are the most highly organized Vertebrates. Both had reptilian ancestors. A bird (Fig. 261) is a *feathered* Vertebrate. Birds successfully and easily navigate the air. They are warm blooded and the blood has a constant temperature, somewhat over

100° F. The fore-limbs are wings (Fig. 262). The skeleton of the wing shows fundamental resemblances to the limb plan of the amphibian and reptile but with adaptive modifications. The bones of the shoulder girdle, wrist and hand are modified to form the wing skeleton. The broad surface of the wing is useful not only as a propeller but also as a support in the air. The pectoral muscles are enormously enlarged for the operation of the wings of flying birds and the breast bone is increased in size to afford a larger surface area for the attachment of these greater muscles.

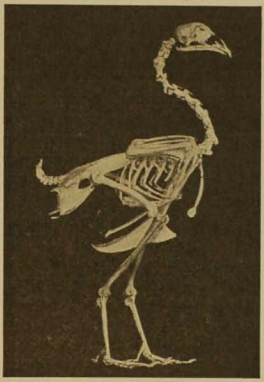

Fig. 262. — Skeleton of common fowl — Gallus.

The long tail of other Vertebrates is represented in birds by a few vertebrae which form a short stump. There is a movable neck. Birds are bi-pedal and the structure of the hind limb is modified for this method of body support or locomotion. Bi-pedal land locomotion is necessitated by reason of the fact that the front limbs are used for flight. The entire skeleton is knit into the compact, light frame of a flying machine. Many of the bones contain air spaces. There are no teeth in the jaws, which instead are encased in horn. The beak is a very useful tool. Food passes from the oesophagus into the thin, saccular crop in which it is softened. From the crop it passes into the glandular portion of the *stomach*, where gastric juice is added to the food. Behind this is the thick, muscular gizzard whose contractions, aided by small pebbles swallowed with food, act like a mortar and pestle or mill in grinding the food. Behind the gizzard is the small intestine, where further digestion takes place and where the simplified food compounds are absorbed into the blood stream. The short large intestine is connected posteriorly with the cloaca. A large liver, a pancreas and ductless glands are present as in other groups.

The blood consists of plasma, white corpuscles and nucleated red-blood corpuscles. The heart has two auricles and two ventricles. The venous body blood enters the right auricle and goes into the right ventricle; thence to the lungs, thence to the left auricle then to left ventricle and thence into the *single* aorta, from which it is distributed throughout the body. There is a long windpipe. At the junction of the windpipe with the bronchi is the *syrinx*, the voice-box of birds. The lungs are composed of multitudes of minute alveolar sacs connected by very fine bronchial tubes to larger branches and so to the windpipe. A much greater area of respiratory surface is thus provided for than is the case in lower groups. There is a special system of air reservoirs connected with the lungs of birds. When filled, they form inflated spaces in the body cavity. Ducts from these extend into the bones of the limbs. The mechanism for the exchange of respiratory gases is of a high order. The greater respiratory

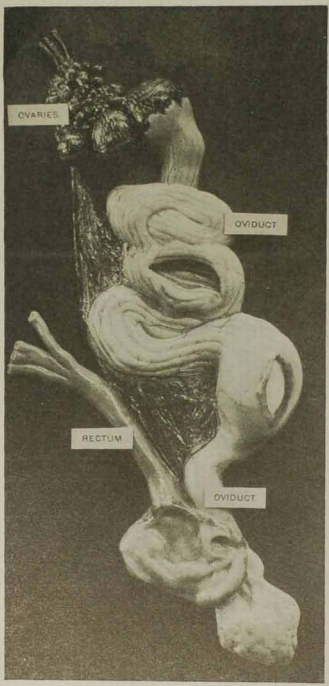

FIG. 263. — Reproductive organs of hen. (Amer. Mus. Nat. Hist.)

surface involves a greater and more rapid exchange of respiratory gases and this in turn means higher rate of metabolism.

This is also true of mammals. Birds and mammals live more intensely than do the lower forms. Birds are on a par with some of the insects in sustained persistence of active movements.

There is no urinary bladder in birds. The urine is semi-solid. Some water is excreted with expirations. The right ovary and oviduct usually degenerate (Fig. 263). There is usually no special organ of copulation, but nevertheless copulation takes place and fertilization is internal. The hen's egg (Fig. 264) hatches in about 21 days and that of the pigeon in about 14. During the *incubation* period the eggs are kept at a temperature of about 100° F. by the warm body of the female bird, as a rule, although in some cases both mates take turns in performing this function. After hatching, the young birds are soon able to forage for themselves. The sense of hearing is highly developed and the visual sense still more so. The cerebral hemispheres are highly developed although the cortical surface is smooth and not convoluted as in many mammals. Birds resemble reptiles in the possession of an amnion, allantois, large-yolked eggs with shell, cloaca and scales on the legs. Some of the differences have been noted above. Birds are exceptionally uniform in general structure. Differences are largely in details. On this account it is difficult to subdivide the group into well-defined differentiated types.

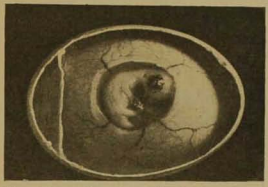

FIG. 264. — Ten day old chick embryo. (Photo by Amer. Mus. Nat. Hist.)

Classification

There are two great subdivisions, A. Archaeornithes and B. Neornithes.

Sub-class 1 — Archaeornithes. These are represented by a single fossil species, *Archaeopteryx lithographica*. Only two specimens have ever been found. These were taken from Solenhofen lithographic stone in Bavaria. This rock belongs to the Jurassic Period. Archaeopteryx was about the size of a crow and the body

was covered with feathers as in modern birds. It had small, uniform teeth in both jaws, twenty-three vertebrae in the tail and each vertebra possessed a laterally placed feather on either side, forming a large, flat tail. The ends of the second, third and fourth digits of each wing were *clawed*. The bird probably used all four legs in climbing trees. A study of the structure of Archaeopteryx indicates that it is intermediate between reptiles and modern birds. Its discovery proved that birds appeared during the Mesozoic Era.

It is considered of more than passing significance that a modern bird belonging to the next sub-class possesses certain *primitive* features. The young hoactzin of British Guiana has claws on its wings and uses both pairs of limbs in climbing.

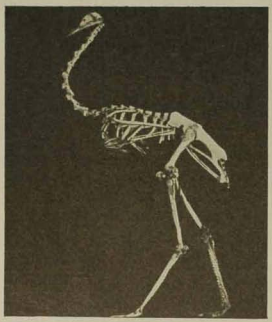

Fig. 265. — Skeleton of ostrich.

Sub-class 2 — Neornithes. These are modern birds. There is a short tail composed of a few fused vertebrae, around which the tail feathers are arranged like a fan. A few extinct forms had teeth. Two groups are distinguished.

Division I. Ratitae. These are large birds in which the wings are of small size or are absent. Wing muscles are small and weak and the sternum has no keel. On the other hand, the hind limbs are large and very strong. Ratitae are walkers or runners and distinctly terrestrial in habit. Ostriches (Fig. 265) are native in Africa, southwest Asia and South America. The cassowary (Casuarius) and emu (Dromaeus) are found in Australia and the kiwi (Apteryx) in New Zealand. The moa (Dinornis), a very large, wingless bird, has become extinct within the last five hundred years. Moas lived in New Zealand, and some of them were ten feet high with enormous legs.

Division II. Carinatae. These birds are for the most part equipped for flight with well-developed wings and wing muscles. Familiar birds such as the robin, sparrow, bluebird and eagle

belong to this group. No separation into orders will be attempted here.

General Remarks. The size of the egg is related to the size of the bird. The egg of extinct Aepyornis was about 150 times that of the hen. The egg of the moa was nine inches in diameter and a foot in length. Song birds, as a rule, are naked, blind and helpless at hatching, while young chicks are covered with feathers at *birth* and are quite active a few hours later. Birds usually molt their old feathers after the breeding season and grow new ones to replace the old. The ptarmigan (Fig. 266) molts three times a year. It is white during the winter's snow; mottled brown in the spring and gray after the breeding season.

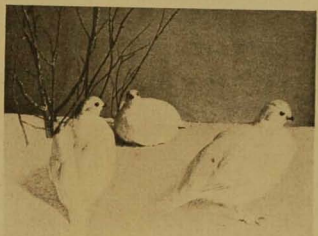

FIG. 266. — Ptarmigan in winter. (Amer. Mus. Nat. Hist.)

The migration of birds is not well understood. Notwithstanding the variations in weather from year to year, birds keep a regular schedule. Some come back to the same nest year after year. They fly day and night, over land and sea and for long distances. Food conditions, temperature and problems of rearing the young appear to be factors concerned with migration. Some birds exhibit the phenomenon of courtship prior to or during the mating season. Males are often highly colored and plumed while females are plain in appearance. Darwin thought that the highly decorative feathering of the male was brought about by a sort of selection. He maintained that the female selected the " handsomest " males and that generations of this so-called *sexual selection* produced the marked differences between the sexes. He attributed sexual dimorphism among insects to sexual selection, also.

Domesticated birds produce for man an income of millions of dollars annually. The ancestor of the common fowl was probably *Gallus bankiva*, the jungle fowl of India. Domestic pigeons have been likewise produced from the wild rock-pigeon, *Columba livia*,

of Europe, Asia and China; domestic geese from the wild *Anser anser* of England and most of the ducks from the wild mallard, *Anas boca*. Birds have, as has been said, a structural similarity to reptiles. Huxley called birds "glorified reptiles." The biologist concludes that birds had reptilian ancestors, but they have long since diverged and advanced from them. From sluggish, cold-blooded, scaly and, to most people loathsome, reptiles, have evolved the birds, active, warm-blooded, beautifully feathered creatures. The mental attitude of the average man toward birds is the antithesis of his feelings toward amphibians and reptiles.

Phylogeny. From the Stegocephali arose the reptiles, probably by more than one line of evolution, as suggested by the following: (*a*) A line through Rhyncocephalian-like forms to the present snakes and lizards; (*b*) a line of which one branch ends in the Chelonia and another branch in the Crocodiles which, of all extant reptiles, are associated with the Dinosaurs. But this line continued through reptile-bird forms, suggested by Archaeopteryx, and ended in the modern birds. (*c*) Still another line of reptiles evolved through primitive Theromorpha, more mammal-like than reptilian, and ended in the Mammals. See Appendix B.

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