The Story of the Evolution of Life

BY T. F. PALMER.

(Continued from last issue)

Similar modifications have occurred in the structure and arrangement of the tails of birds. An extinct bird, betraying its close relationship with the reptiles, possessed a long reptilian tail, each of the twenty-one joints of this appendage bearing a feather on each side. This is the famous toothed bird, the Archaeopteryx, which is so reptilian in character, that it was first regarded as a reptile, and then as a transition form between reptiles and birds. At a later date than that of the Archaeopteryx there lived toothed birds whose remains show that they more closely approached modern forms. Now, in present-day birds, the tail points have been reduced in number and broadened in shape, and at their termination carry a shaft of feathers. And it is highly instructive that the young of living birds, as they develop in the egg, pass through the tail stage shown in the Archaeopteryx, and then through that of the more recent toothed birds, until they reach the condition in which we find the tail in extant forms. Again is illustrated the truth that animals in the course of their development travel through the stages their ancestors have experienced in their onward advance. Indeed, the same generalisation holds good for all tailess animals, and thus we conclude that they have arisen from tailed ancestral forms. And not only does the Archaeopteryx plaintly proclaim its reptilian descent in its tail and teeth—and no living bird possesses teeth—but its limb bones, both of the wings and feet, are markedly reptilian in charter.

Until recently nothing was known of the pedigree of the modern elephants, but the evolutionary history of these animals is now remarkably complete. Dr. Andrews and others have shown that from a big-footed, five-toed, short-snouted, swine-like animal, the various extinct and contemporary elephants have been evolved. Various other animals have slowly yielded the secrets of their ancestral history. Among these are the camel and the horse. The evolution of the latter through the Tertiary Period, or Era of Mammals, furnishes a splendid illustration of the transformations which have gradually led to the horse as it exists today. The ancestry of the equine family has been traced back to an early stage of the Tertiary Period without a single important break. Beginning with the Eohippus, an animal smaller than a fox, with four toes on its fore foot, and a mere splint representing the dwindled fifth toe, twelve evolving stages have been determind in the line of the horse's ascent. Each succeeding stratum yields evidence of the steady evolution of the race until it attained its present form. Commencing then with the Eohippus, which walked on several toes, there has been developed an animal which is distinguished from all others by the possession of one toe only on each foot. Anatomists are agreed that this toe is the third or middle digit of the foot. The horse's "hoof corresponds to the nail of a man, or the claw of a dog or a cat, and is broadened out to afford a firm, strong support on which the whole weight of the animal rests. . . . . So it may be said that the horse is an animal that walks on its middle finger nail, all the other fingers having disappeared."

During the period which witnessed the rise of the horse, elephant, and indeed all other mammals, the camel was coming into being. The history of this animal's evolution is almost as completely established as that of the horse. The camels are now restricted to Africa and Asia, and their relatives the llamas, to South America, and their fossil remains in their present range are not very ancient. But in the Tertiary rocks of North America has been discovered a series of animals which represents the ancestors of the Camel group, and connects them with earlier hoofed quadrupeds from which many other forms are also descended. In the Lower Eocene deposits occurs the extinct Trigonolestes, a camel-like creature smaller than a cotton-tail rabbit, with teeth of a primitive pattern, and provided with four complete toes, the side toes being very slender. It will be observed that one toe of an earlier five had already disappeared. In Upper Eocene Times, Protylopus, an animal as big as a jack rabbit succeeded whose side toes had dwindled to splints, and whose molar teeth were formed like those in modern camels. In the following Period an animal the size of a gazelle appeared, while in the later Miocene Period, in the shape of the skull and the form of the teeth, in the Procamelus and other related animals, the living camels are foreshadowed. The camels of the next stage, the Pliocene, are still nearer to modern forms, while in the final period, that which went before our own, the camels became extinct in their original habitat, but have persisted in the new lands to which they have migrated.

Man is a mammal, one of those creatures that suckle their young at the breast, and the evidences of the changes which the limbs of mammals have undergone in the course of ages are profoundly important. The changes which have taken place in the structure of hands and feet are mainly of two kinds. These chiefly consist in the dwindling of some parts and the great enlargement of others. Professor Romanes selects the skeleton of a bear in order to illustrate the fact that the fore limbs and hind limbs of mammals, all in their origin four-footed creatures, including man himself, are made up of the same bones, just as we find the identical bones in the hands and feet of monkeys and men. Like ourselves, the bears walk on the soles of their feet. This means that the bones of the fingers, toes, feet and ankles rest on the ground. The bear, then, like man, is a plantigrade animal, and plants his feet firmly on the earth. But most mammals move on their fingers and toes. They walk on their digits, and are termed digitigrade animals. One has merely to watch a cat or dog to notice that such animals progress exclusively on their fingers and toes, the remaining bones on the fore and hind limbs, including the ankle and wrist, being raised above the ground. Fortunately we possess a complete record of the changes which have led to the development of the modern mammalian limb. Reptiles long since extinct, possessed a very primitive type of limb. These creatures were water-dwellers, and their hind limbs resemble the fin of a fish almost as closely as they resemble the limbs of a mammal. For as Romanes pointed out: "Not only are there six rows of bones, instead of five, suggestive of the numerous rays which characterize the fin of a fish, but the structure as a whole having been covered over with blubber and skin, was throughout flexible and unjointed—thus in function, even more than in structure, resembling a fin."

This type of limb was eminently serviceable to an animal living in water, but when backboned (vertebrated) annmals began to seek a home in the land, the limbs had to be adapted to terrestrial movement. Limbs more firmly set were now required, and more solid structures were developed. Moreover, the loosely formed limbs of the aquatic reptiles now became more specialized, and began to approach the later purely mammalian type. The kind of limb evolved in these early land reptiles was favorable to sluggish movement over marshy soil. And when reptiles first emerged from the river, lake, or sea, they were restricted to the near neighborhood of the aquatic environment of their ancestors. Further progress was now necessary, and organs were evolved which enabled quadrupeds to wander over harder and less even land. The earlier types of land animals were plantigrade, but the digitigrade forms were developed from them. These last, which, instead of progressing on the whole foot, move on their toes, evolved on two separate lines. Some mammals such as the elephant and cow all walk on their toes, and these quadripeds are arranged into two classes —the even-toed and odd-toed. This apparently trivial distinction is in reality very important. For in the struggle for existence an odd-toed animal with five toes has in various instances secured considerable advantages by gradually sacrificing its fifth toe, thus gaining greater stability with the remaining four. Probably all ancient mammals were five-toed, but as heavier and heavier demands were made on certain of the digits, these became larger and stronger, while those less in use slowly dwindled away.

As we have seen, this aspect of evolution is vividly portrayed in the fossil pedigree of the modern horse. And the history of the changes undergone in even-toed mammals is also instructive. The outer digits of the foot of the pig, camel, and deer display successive stages of dwindling. In the deer, the aborted digits are smaller than those of the pig, although two only in each animal are truly functional, while in the case of the camel, the two exterior toes have completely vanished. In the pig, the separate bones of the two outer toes are still plainly visible. In the deer, the smaller digits are more closely united to the larger ones, while in the camel they have become part of the surviving toes, although they still retain slight indications of their previous independence. In these examples, as in so many others, too numerous to be cited, a study of the unborn young supplements the testimony furnished by anatomical inquiry, for we discover that in the embryo, the two bones in question are distinctly separate, and thus preserve in the living, if unborn animal, those identical features which were once the normal characters of the adult forms of several long extinct species of hoofed mammals.

Other parts of the animal framework present quite conclusive proofs of evolution. Alike in the vertebral column, and the structure of the teeth, are to be found overwhelming evidences of the truth of the theory. A survey of a comparative series of brains again, reveals the verity that the brain of the fish is comparatively simple in structure, that of the higher reptile less simple, that of the yet higher bird less simple still, while although the brain of the most primitive mammals was small, it was far better organized than that of its reptilian ancestors. As the mammals developed, their brains increased in size and in complexity, until we reach the highly elaborated cranial contents of the most intelligent mammals such as the dog, elephant, ape, and man.

Fossil shells have provided powerful proof of modified descent. To select two instances out of scores, there are the mollusk shells of Steinheim and those of Slavonia. In Wurtemburg, near the hamlet of Steinheim, there lies a dried-up lake, the deposits of which are crowded with shells, largely of the several species of Planorbis. Professors Hyatt and Hilgendorf made a very careful examination of this deposit which had remained undisturbed for many thousands of years. Their results as stated by Prof. Le Conte were as follows:—"In passing from the lowest to the highest strata the species change greatly and many times, the extreme forms being so different that, were it not for the intermediate forms, they would be called not only different species, but different genera. And yet the gradations are so insensible that the whole series is nothing less than a demonstration, in this case at least, of origin of species by derivation with modifications."

The Paludina fossil shells from the lake basins of Slavonia present another striking proof of evolution. Professor Neumayr arranged a complete series of seventeen forms, each of which provides ocular demonstration of progressive change. Yet as Romanes remarked "Before the series was completed, some six or eight of the then disconnected forms were described as distinct species; but as soon as the connecting forms were found—showing a progressive modification from the older to the newer beds—the whole were included as varieties of one species."

The evidence that the Italian, French, Spanish, Portuguese, and in large measure the English language, have been evolved out of a dead or fossil tongue—Latin—no one dreams of disputing. Were the documentary and other evidences of this devel-

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