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THE BIRDS

by Roger Tory Peterson
and the Editors of
TIME-LIFE BOOKS

TIME-LIFE BOOKS NEW YORK

About the Author

Roger Tory Peterson's first ambition was to be a painter of birds, but feeling that he could not make a living at that, he went to art school in the hope of succeeding as a commercial artist. Birds, however, remained his passion. He took a job with the National Audubon Society, painted birds when he could, and eventually was able to persuade a publisher to put out a bird guide full of his own illustrations and introducing a new system of field identification. This is now known wherever birds are studied as the Peterson System. It has revolutionized bird watching and made its inventor the best-known ornithologist in the world. The first Peterson *Field Guide*, which was devoted to birds of America, was followed by others on a dozen different countries. All together, they have sold nearly two million copies.

This extraordinary success has enabled the man who "couldn't make a living painting birds" to travel all over the globe, observing, painting and photographing his favorite creatures. Along the way he has written and lectured widely and is a past or present officer of 18 leading ornithological organizations. He has been awarded the Brewster Medal of the American Ornithologists Union, the John Burroughs Medal, the Geoffrey St. Hilaire Gold Medal (France) and medals from the New York Zoological Society, the National Audubon Society and the World Wildlife Fund. He holds honorary degrees in science from Franklin and Marshall College and Ohio State University. He and his family live in Old Lyme, Connecticut.

ON THE COVER: A white tern flutters to a landing on Midway Island. Unlike other terns it balances its egg on the bare branch of a tree, not bothering to build a nest.

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Introduction

SINCE birds, like men, are largely diurnal creatures and share with us the familiar daytime world of color and sound, our association with them is, not surprisingly, a long and intimate one. Man has always had a double interest in birds—on the one hand esthetic, personal, impractical; on the other, utilitarian. The latter has changed with the times and with the sum of human knowledge. Long ago, when superstitions and priestly cults were the "science" of the day, the flights of birds were carefully studied for omens, as were their entrails. For centuries man tried to probe the mysteries of flight. Although he never succeeded in duplicating the effortless, endlessly flexible aerial mastery possessed by birds, he does share the air with them today. That leads inevitably to the problems of navigation and space travel, and we find ourselves turning to the birds again—for evidence is accumulating that they chart their courses, during migration, by the sun and stars. Will we learn anything about navigation from them? Conceivably, although it is likely that we will succeed only in developing something which, in comparison to the way the birds do it, will turn out to be as crude and expensive and inflexible as a propeller-driven plane when compared to a feathered wing.

Birds have helped men for thousands of years, from the geese whose warning cries saved Rome to the canaries that were used to warn coal miners of methane gas leakage. Truly, birds touch us in unexpected places. They are far more to us than ducks and pheasants to be shot, or chickadees and cardinals to brighten a suburban winter.

As a gifted painter of birds, and in a sense creator of the modern system of field identification of birds, Roger Peterson should not be expected to master other skills. And yet he is an accomplished photographer. I once spent a day with Roger in Rhodesia as he photographed greater kudus, lilac-breasted rollers, African lions and other assorted fauna. I was struck by his care and persistence, and I suggest to the reader that he turn to the picture credits on page 186 of this book to find examples of Roger's skill with the camera. Here is a man who can do everything, including write. Small wonder that the editors of TIME-LIFE BOOKS were delighted to have him as the author of this fine volume.

DEAN AMADON
Lamont Curator of Birds, Department of Ornithology,
The American Museum of Natural History

EARLIEST KNOWN BIRD, *Archaeopteryx* left its semireptilian print in clay. It had feathers, but probably it was a poor flier, spending much time on the ground. Wing claws helped it clamber about in trees.

1

From Archaeopteryx to Sparrow

WHAT manner of creatures are birds? Certainly, of all the higher forms of life, the vertebrates, or backboned animals, they are the most beautiful, most melodious, most admired, most studied—and most defended. They far outnumber all other vertebrates except fishes and can be found virtually everywhere throughout the world, from the edges of the polar icecaps and the highest Himalayan and Andean slopes to the roughest seas, the darkest jungles, the most barren deserts and the most crowded cities. The center of the Antarctic continent is the only place on the world's surface where birds have not been found. Some even invade the fishes' environment to a depth of 100 feet or more, while others hide in caves so dark that they must employ a sort of built-in sonar to find their way about.

Nearly a century ago T. H. Huxley called birds "glorified reptiles." This term may grate harshly on the ears of gentle souls who keep parakeets or feed cardinals at the window, but there is much to support Huxley's contention. Birds share many characteristics with reptiles—certain skeletal and muscular features, similar eggs, an "egg tooth" on the upper jaw at hatching time, to name just a few. But the unique feature that sets them apart from all other

animals is that they have feathers. All birds have feathers, and no other creatures possess them.

Considering the fact that life on earth extends back into the spectrum of time for more than two billion years, birds are a latter-day creation. Paleontologists believe that they began to branch off from reptilian stock sometime about 150 million years ago, shortly after the first mammals.

The oldest known bird in the fossil record dates back to the late Jurassic period, about 140 million years ago, and although there must have been still earlier birds or subbirds, this one has a dramatic significance all its own. It was brought to light in a slate quarry at Langenaltheim, Bavaria, in 1861, and would have been classified as a reptile except for the unmistakable imprint of feathers. The discovery was a scientific bombshell. Only two years before, in 1859, Charles Darwin had published his then controversial work, the *Origin of Species*—and here was beautifully imprinted proof of his new theory, a missing link from the past: evidence that birds had evolved from reptiles. The fossil was named *Archaeopteryx*, meaning "ancient wing." In 1877 a second skeleton was discovered about 10 miles away and in 1956 a third was found.

FOUR FOSSIL BIRDS

ICHTHYORNIS

After 50 million years birds had come a long way from the reptilian Archaeopteryx. Ichthyornis was about the size of a pigeon and probably looked somewhat like a modern tern. It lived on the shores of North America's great inland sea about 100 million years ago and was probably a skillful flier, but had small weak legs.

HESPERORNIS

Hesperornis also lived 100 million years ago on America's inland sea. It resembled a modern loon, with legs set well to the rear. A strong swimmer, it had only rudimentary wings and could not fly. Its beak was lined with sharp reptilian teeth. More than one Hesperornis species evolved, the largest being the size of a small seal.

ALTHOUGH not quite a bird in the modern mold, *Archaeopteryx* was certainly not a true reptile. Its head, however, was lizardlike, with toothed jaws, its slender tail with many movable vertebrae was skeletally like that of a reptile, and its wing bones terminated in three slender, unfused, clawed fingers. Still, it had *feathers*.

Archaeopteryx probably did not fly easily. If we rationalize from its appearance, we might assume that it ran over the ground on strong legs and clambered up rocks, shrubs and trees with the assistance of its clawed wing-fingers. Its rounded wings and long but rather wide tail suggest that it was a glider that launched itself only for short distances, like a flying squirrel. It is perfectly clear, from studying its anatomy, that it could not have flown very well. We can easily imagine the predicament which led to the fossilization of the three individuals so long ago. They were probably forced into reluctant flight by some pursuing reptilian predator, only to flop down on the water and mud from which they could not rise.

To this day, *Archaeopteryx lithographica*, which was about the size of a pheasant, remains the only known species representing the subclass archaeornithes, or "ancestral birds," and we can only guess at the type of reptile from which it descended. This may have been one of the thecodonts, the possessor of long hind limbs on which it ran semierect, using its long tail as a balance.

Concurrently, also during the Jurassic, another reptilian experiment in flight resulted in the pterodactyls, which flew on slender batlike wings of skin. Though these creatures developed certain birdlike features such as beaks and light, pneumatic bones, they were not destined to survive. The Cretaceous period, which started about 135 million years ago and ended roughly 63 million years ago, saw their proliferation and also their demise while witnessing the rise of the "true birds."

These were the neornithes, birds such as *Hesperornis*, a toothed diver resembling a huge flightless loon four or five feet long, and *Ichthyornis*, a small ternlike sea bird. Their remains were discovered in the Cretaceous shales of Kansas. A cormorantlike bird also lived during this period and a primitive flamingo has been found in Scandinavia, so it is obvious that water birds had already diverged widely in form and adaptation by this time.

The current era is often called the Age of Mammals, as distinct from the Age of Reptiles, which drew to a close with the exit of the dinosaurs and pterosaurs. The early part of this era, the Paleocene and Eocene, 63 to 36 million years ago, was a time of great development which saw the ascendancy of birds over reptiles. Many of the modern orders of birds emerged—including an ancestral ostrich, and primitive pelicans, herons, ducks, birds of prey, fowl-like birds, shore birds, owls, cranes and others. As we advance further, through the Oligocene and Miocene, 36 to 13 million years ago, we find many modern genera appearing, birds very similar to present-day forms. A modern bird watcher, stepping back into time about 20 million years to scan a Miocene lake with his binoculars, would spot many familiar-looking individuals but none that he could match precisely with those of today. But there also existed certain other birds that were in blind alleys; for example the phororhacids, huge flightless birds with massive heads nearly as large as those of horses. These fearsome fowl left no modern descendants.

During the Pliocene, 13 to 2 million years ago, many species emerged that fly on earth today—species that can claim antiquity far greater than that of man. This was the period when birds enjoyed their greatest variety. Pierce Brodkorb of the University of Florida estimates that about 11,600 species were living contemporaneously, a third more than exist today.

The Pleistocene, lasting one or two million years, when man was slowly coming into his own, was a time of pressure and extermination. The world was playing hot and cold with living things, alternating between glaciation and benign interglacial periods. The great ice sheets eliminated many plants and the birds scattered accordingly.

Today the number of species of birds on earth is usually estimated to be about 8,580, give or take a few score and depending on which systematist you choose to accept. The total number of extinct species described from fossil evidence is in the neighborhood of 800—less than 10 per cent of the living species.

ACTUALLY, any paleontologist will point out that this does not give even a remotely true picture of the number of species that have existed during the last 140 million years. Birds, with their fragile, hollow bones do not lend themselves as well to fossilization as mollusks with hard shells or mammals and large reptiles with their relatively solid bones. The road from *Archaeopteryx* to modern birds is paved with genesis and extinction. Species have arisen, have had their day and have faded away or given rise to new forms better adapted to a changing world. Recently Brodkorb, drawing on his knowledge of fossil history, came up with a tentative, over-all figure of 1,634,000 species, past and present. The living birds made up scarcely more than one half of one per cent of this total. The others have followed *Archaeopteryx* into the void.

The biologist often speaks of "adaptive radiation." This means, in the evolutionary sense, that the descendants of a single species of animal may adapt to a number of new environments or modes of life. By so doing, they "radiate," changing in form and structure away from the ancestral type to a number of divergent types.

Adaptive radiation was strikingly revealed to Darwin when his research vessel, the *Beagle*, dropped anchor at the Galápagos Islands 600 miles off the coast of Ecuador in 1835. Here he found a complex group of small, dark, finchlike birds now known as the Geospizinae. They were similar enough to be recognizable as a group that had presumably descended from a single source, perhaps some

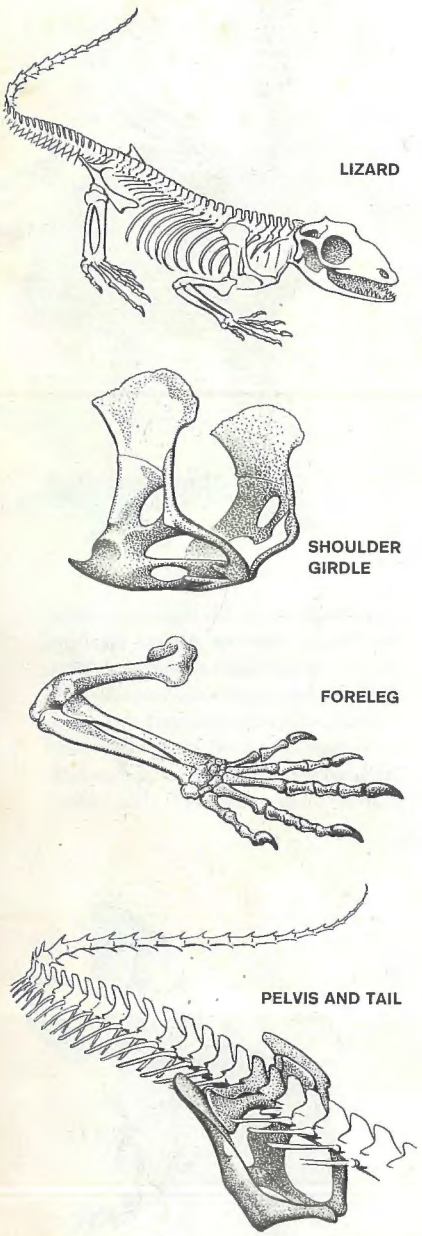
DIATRYMA

A 60-million-year-old flightless giant of the North American plains, this bird stood seven feet tall and had a head as large as that of a horse. Its huge sharp bill and powerful legs suggest that it was a predator that lived by running down small reptiles and mammals, in much the same way as the secretary bird does today.

PHORORHACOS

Related to Diatryma and with a similar predatory bill and rudimentary wings, Phororhacos was somewhat smaller—about as tall as a man. It lived in South America 30 million years ago, unhindered by the large predatory mammals that later emerged there. The modern cranelike cariama of South America may be akin to it.

EARTHBOUND REPTILE TO AIR-BORNE BIRD



Although descended from the same reptilian ancestors, lizards and birds have diverged considerably in structure. A typical lizard today has a long backbone and an even longer tail. Its solid frame and stout limbs, with many movable bones, are well suited to its four-footed gait.

Its shoulder girdle is strong, made of three heavy bones, but the breastbone is shallow, since large chest muscles are not needed by lizards. Short sprawling forelegs give the lizard a built-in crouch, but it uses an ankle of many elements and a five-toed foot to run swiftly. The pivot point of body weight is the pelvis. Up to 100 tail vertebrae provide rear balance.

seed-eating ground finch carried by the wind to these remote islands. Perhaps a small flock made the sea passage together. Surviving, these first wind-borne immigrants found no other small birds to offer competition. Environmental niches were empty, so eventually the colonists, prospering and increasing, adapted to various modes of existence. When Darwin made his historic visit he found that some Geospizinines were seedeaters as their ancestors are presumed to have been, but that others fed on insects, still others on cactus and one form even filled the role of a woodpecker. Their bills varied from thin, warblerlike bills to very thick beaks like those of grosbeaks. They had, in fact, evolved so as to exploit virtually every feeding opportunity the islands offered to small birds.

When we discuss Galápagos finches we are talking about relatively recent radiation. Consider the extraordinary radiation from *Archaeopteryx* to the bewildering array of modern birds.

EVOLUTION is a fluid process which can be represented by a two-dimensional family tree, but more accurately it is three-dimensional, with many twigs and branches dying off while others, reaching out in all directions, continue to modify and grow. The 8,580 species of birds on earth today represent growing twig ends. They are separate entities, populations that for one reason or another normally do not or cannot interbreed with each other. They are reproductively isolated. This large galaxy of living species has been arranged by systematists into 27 living orders of birds and these in turn have been broken down into some 155 families.

No one ornithologist has ever seen all the world's species in life—or even all of the families, except possibly in zoos. In fact, few are familiar in life with every order. For it is indeed an amazing diversity that exists in the world's population of birds, from the fragile hummingbird weighing less than a penny to the ponderous ostrich weighing more than 300 pounds.

Several of the lower orders of birds cannot fly—the ostriches, the rheas, the cassowaries and emus, the kiwis and the penguins. This gave rise to a theory that modern birds did not all come from a common ancestor, but represented two lines of descent—one that had long ago attained flight and one that is not yet off the ground. Those who held this view theorized that the ostriches and other ratites (flightless, running birds with no keel on the breastbone), as well as the penguins, never had been able to fly and were still evolving their wings. However, this view has now been written off and it is accepted that these flightless birds did have flying ancestors but lost the use of their wings because flight was no longer useful to their mode of life. In fact, flight becomes impossible for creatures as ponderous as the ratites, birds large and heavy enough to fill the niche of grazing animals.

Although the ostrich, with its heavily muscled bare thighs, is the largest living bird, even larger species were seen by primitive man not many centuries ago. These were the moas *(Dinornis)* of New Zealand and the elephant birds *(Aepyornis)* of Madagascar. The largest of the moas, like a huge pinheaded ostrich, stood 12 feet tall and is estimated to have weighed 520 pounds. Moa "graveyards" containing hundreds of skeletons have been found in New Zealand and certain of the smaller moas were still numerous a thousand years ago when New Zealand's first settlers arrived. There is evidence that one species existed in the South Island into the 18th Century.

Less is known about the elephant birds, which some like to speculate were Marco Polo's rocs. They were even more heavily built than moas and may have

weighed as much as half a ton. Whether man destroyed the last of the elephant birds and, if so, how recently, is not known. Early travelers to Madagascar described *Aepyornis* eggs which were used as flasks by natives. A few such flasks are still in existence and they hold two gallons of liquid.

The ostrich, the giant among living birds, attains a stature of eight feet. It lives the life of a grazing animal, roaming in little parties over the African veldt in the company of zebras, wildebeests and gazelles. It has the distinction of being the only bird with two toes, one much reduced in size, suggesting that this fleet-footed monster, which can run as fast as 35 miles per hour, is on its way to acquiring a one-toed foot like the horse.

The two rheas, often called the "South American ostriches," are superficially like their African counterpart, but they have three toes and feathered thighs, and lack the ostrich's handsome plumes. Nevertheless, as they race across the pampas, they give much the same effect as small ostriches.

Australia also has its ratites, or ostrichlike birds—the emus and the cassowaries. They, too, are without the ostrich's plumage, and they have even more rudimentary wings and a hairy, almost shaggy look. Australian farmers hold a perpetual grudge against the fast, 120-pound emu because it damages fences and raids crops. Less often seen are the related, forest-dwelling black cassowaries of northern Australia and New Guinea. Papuan natives have a cautious respect for these temperamental birds which have been known to disembowel men with quick slashes from the long, daggerlike nails on their inner toes.

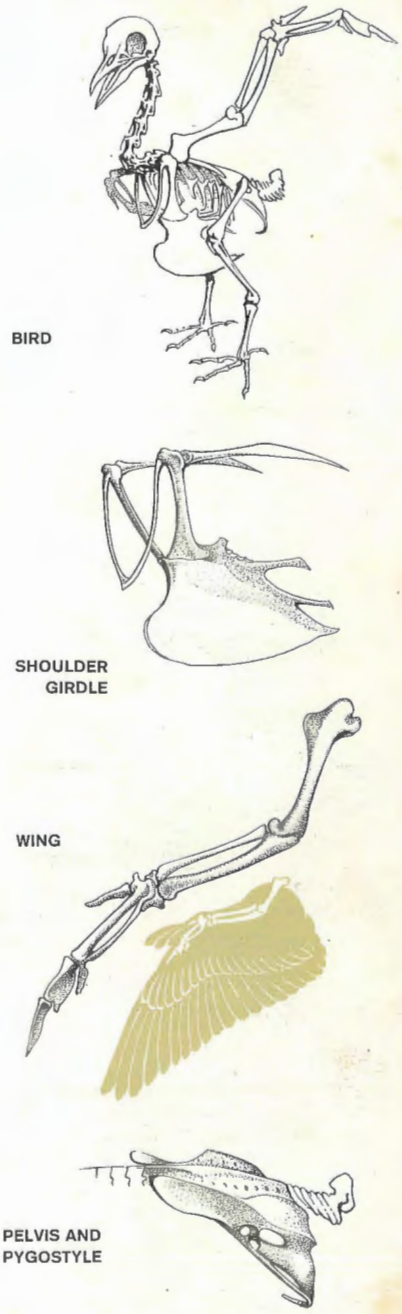
The strangest and perhaps most primitive of all the ratites are the kiwis of New Zealand. Certainly they are the most unbirdlike of all birds, shmoolike creatures shaped like large, hairy footballs and practically devoid of external wings. They have whiskery faces and nostrils placed at the very tips of their long beaks, the better to locate worms during their nocturnal forays. The kiwi's enormous five-inch egg weighs nearly a pound, one fourth to one third of the bird's body weight. Contrast this with the six- to eight-inch ostrich egg, which weighs only one sixtieth as much as the female!

FROM Mexico southward throughout most of the South American continent live the tinamous—chunky, almost tailless birds that lay deeply colored eggs so glossy that they look like porcelain. These ground birds with the haunting, whistled cries look strikingly like partridges, but are not even distantly related to them. Evolution often results in unrelated birds looking rather similar, especially when they fit a similar environment—a phenomenon called "convergence," the opposite of radiation. Tinamous are low in the family tree of living birds, supposedly close to the flightless ratites, but they still have the ability to fly.

The torpedo-shaped loons and the smaller, lobe-footed grebes are both foot-propelled divers with feet placed far back toward the tail. At first glance they would seem to belong to the same order. Actually, they are quite unrelated, coming from different ancestral lines—another example of convergence.

Penguins cannot fly, yet they have a strongly keeled breastbone and powerful flight muscles. Here, the wings have evolved into flippers, and penguins literally fly through the water, using their fleshy feet as rudders. Because their upright posture, waddling gait, dangling flippers and frock coats all add up to a lovable caricature of *Homo sapiens*, penguins have always appealed to humans. All but one of the 15 living species are birds of the cold seas of the Southern Hemisphere.

Oddly enough, the flightless penguins may have evolved from the same



Compared to a lizard, a bird is a lightweight flying machine of few skeletal parts. Body bones flattened and welded onto a short backbone support the wings.

The collarbones are fused into a single "wishbone." The breastbone has a deep keel to provide a surface for attachment of large flying muscles. The wing is a lengthened forelimb. As shown in color, the arm carries the short flight feathers. The wrist and three-fingered hand together support the long primaries. The pelvic bones and lower backbone form a rigid unit. The tail feathers are anchored in the fleshy "pope's nose," close to the pygostyle, a fused remnant of the lizard's tail.

ancestral stock as the albatrosses, the supreme masters of flight. Students point out that they have in common a beak made up of horny plates, quite unlike the simple sheathlike bills of most other birds. Eons of evolution have made one an avian submarine, the other a sailplane.

Albatrosses, petrels and shearwaters all belong to the order of "tube-nosed swimmers," so called because the nostrils, unlike those of most other birds, are in short tubes on the sides or on the top of the bill. They are the blue-water seaman's companions and range in size from the swallow-sized black-and-white storm petrels to the wandering albatross, whose wings span more than 11 feet. Although they roam all oceans, the majority of species live in the Southern Hemisphere and are especially numerous between the Antarctic ice pack and the southern tips of the continents.

The word albatross was an English corruption of *alcatraz*, the name the Portuguese seaman applied to all large sea birds, especially pelicans. Pelicans, however, are not closely related to albatrosses; they belong to the next great order of birds, the "totipalmate swimmers," which differ from all other web-footed birds by having the hind toe joined to the front three by a web. They also have throat pouches, relatively small in the boobies, cormorants, anhingas and frigate birds, but enormous in the pelicans—some of them have a pouch capacity of nearly three gallons. All birds of this order are fisheaters; most but not all are marine.

MODERN birds, adapting and changing during the last 100 million years, have filled virtually every available niche in the world. About 120 living species of "long-legged waders" have evolved. These birds—the herons, storks, ibises and related birds with stiltlike legs for stalking the shallows and long compensating necks—make their living catching small fish, frogs and other forms of aquatic life. Bills take a variety of shapes—daggerlike or spearlike, upturned, downturned, shoelike and even spoonlike.

The most specialized of all the wading birds are the colorful flamingos. Students hotly debate whether they are more closely related to storks, which they superficially resemble, or to geese. Their gooselike cries, gooselike young, their molts and even their feather parasites suggest an affinity with geese. Certainly they have developed a way of life unique among birds, evolving grotesquely exaggerated necks and legs and thick, bent bills equipped with fringed lips for straining edible organisms from the souplike mud in which they wade.

The waterfowl, the familiar web-footed swimmers which form the sportsman's game, include the ducks, geese and swans. The distinctive feature that most of the 146 species have in common is a flattish "duck" bill, although the mergansers, or fish ducks, are equipped with sawlike mandibles. Some ducks dabble, others dive for a living, while swans, with necks longer than their bodies, dip or tip up for their diet of aquatic plants. Geese, shorter-necked, also do this but primarily graze on land for grass and roots.

Among the most spectacular of all groups are the birds of prey. Superbly designed for their predatory task, they are powerful fliers, capable of effortless soaring or plunging bursts of speed. There are over 270 living species in this order. All have hooked beaks for tearing flesh, and those which take living prey characteristically have strongly hooked talons. Vultures, those naked-headed birds of prey which feed on carrion, have weaker feet—an obvious adaptation, since their prey cannot escape. Owls, though nocturnal birds of prey, are not included in this order; more will be said about them later.

The fowl-like birds, numbering about 250 living species, embrace the grouse,

turkeys, quails, partridges, pheasants, currassows, guans, mound builders and the primitive hoatzin. They are sturdy ground birds, with grubbing bills and stout, scratching toes. Some are among the world's most gorgeous birds; others, notably the domestic fowl, are among the most economically important.

The cranes, rails, coots, bustards and related families, some 185 species in all, belong to an order that, for convenience, we might call "marsh birds." The stately cranes are storklike, whereas rails and coots are more like hens and hide in the reeds. The bustards are heavy-bodied walking birds of treeless plains. All birds of ancient lineage, they may be losing the fight for survival.

The shore birds, gulls and auks form another order, also united because of internal anatomical similarities. The birds of this multifarious assemblage numbering nearly 300 species are highly gregarious and are to be found more widely throughout the world than any other group. The shore birds are small to medium-sized waders that flock along the margins of waterways and the ocean. The gulls and terns are graceful aerialists. Auks fit the same niche in northern seas that penguins do in the Southern Hemisphere, but have not lost their power of flight. Indeed, they have double-purpose wings which enable them to fly through the air and under the water as well.

Four fifths of the world's living birds are made up of the various orders of land birds, which seem to have had their greatest development in recent geological time. The worldwide pigeons, for example, and the Old World sandgrouse, with their small-headed, short-legged look, total more than 300 living species. They are the only birds able to suck up water when drinking; all other species have to tip their heads up to let the water flow down their throats.

The gaudy parrots, which come in all the colors of the rainbow, are big-headed with deep, hooked beaks and dexterous, prehensile feet. Living for the most part throughout the tropics, they number 317 living species. Not far removed from them anatomically but quite different in shape are the worldwide cuckoos and the touracos of Africa, slim-bodied birds with long tails. Their feet, with two toes forward and two aft, as in the parrots, are weaker and lacking in dexterity. If we lump the cuckoos and touracos the order numbers 143 species.

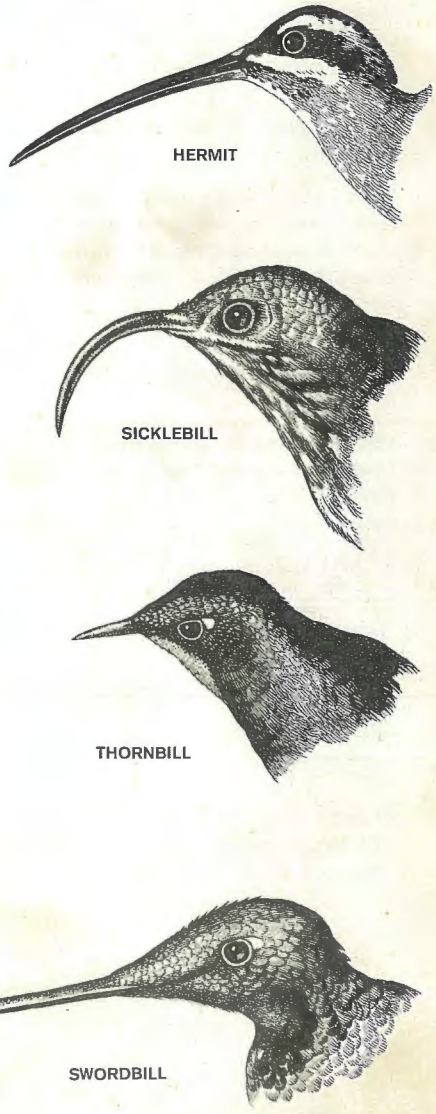
Owls were once classified with the hawks because of their hooked beaks and curved talons, but they are actually unrelated to those predatory birds. Rather they furnish another good example of convergent evolution, birds of separate origin developing similar features because of their way of life. Owls take over the night shift from the day-flying hawks and are best characterized by their loose feathering, large heads and large, forward-facing eyes framed by round facial disks. Nearly worldwide, they number 132 species.

Another order of nocturnal birds, the goatsuckers, possess fluffy owl-like plumage, but their beaks and feet have degenerated into insignificance. They are flying insect traps, capturing their quarry in cavernous gaping mouths. The whippoorwill and the nighthawk are the best-known North American examples of this group, which numbers 92 species.

The most aerial of birds are the swifts, saber-winged, swallowlike birds that spend all their active hours in the open sky. As in the goatsuckers, beaks and feet have atrophied to near uselessness. Most systematists lump the swifts in

THE LONG AND THE SHORT OF HUMMINGBIRD BILLS

Although nobody knows what the earliest hummingbird bills were like, experts suspect that their dimensions were generally much the same as the bill of the hermit, since most modern hummingbirds' bills are similar to it. However, others have diverged in remarkable ways. The sicklebill's has the most extreme curve of any species, the thornbill's is the shortest, and the swordbill's, at five inches, is the longest. Each is especially adapted for feeding from flowers of a particular size and shape.



the same order as the hummingbirds, pointing out that they branched off the same stem. The gemlike, needle-billed hummers, which include the tiniest of all birds, number perhaps 320 species and are all found in the New World. No Old World group has ever become as efficient at the delicate art of nectar feeding.

The layman is puzzled when he reviews the orders of birds. Why are ostriches, rheas and emus put into separate orders when they look so much alike? And why are loons and grebes in separate orders—or hawks and owls? On the other hand, birds as dissimilar as sandpipers and puffins are placed in the same order. So are cranes and coots. All of this becomes even more puzzling when one looks at the orders of land birds.

Systematists find that the superficial appearance of birds may be deceiving. Unrelated birds may look similar because of a similar way of life—evolution has decreed it so, and they have converged. On the other hand, birds may look very different yet have come from the same ancestral stock; they have diverged. For this reason, students are more likely to base their decisions as to the major groups on such points of internal anatomy as the skeleton, the musculature, the palate structure or the anatomy of the foot—characteristics that indicate more accurately their common ancestry.

Thus the colies, or mousebirds, a small group of six African birds with crests and slender tails, have been put in an order of their own, based partly on their curious foot structure. So have the brightly colored tropical trogons, which are among the world's most beautiful birds.

The kingfishers and their allies are another great order of fantastic variety, classified by their peculiar feet, which are "syndactyl," having the front toes joined for part of their length. The kingfishers with their spearlike bills are nearly worldwide. Other gaudily colored families belonging to this order are the tiny, chubby todies of the West Indies; the motmots of the American tropics that pluck the barbs of their own tail feathers so that the tips look like tennis rackets; the handsome bee eaters, the rollers and the hoopoes of the Old World; and the huge, bizarre hornbills of the Old World tropics. All 192 species nest in holes, usually in banks of earth or in trees.

The woodpeckers and their allies, numbering 377 species, are also hole nesters and include such dissimilar families as the barbets with their whiskery bills, the iridescent jacamars and huge-billed toucans. The toucans make up for the lack of hornbills in the New World tropics.

CONDENSED as this brief review has been, it still gives an idea of the great variety of the orders. None, however, can compare with the passerines, or perching birds. This order is by far the largest; it contains just about 5,110 species, which have been divided into about 55 families. They range in size and beauty from tiny wrens to large, gorgeous birds of paradise and lyrebirds. This galaxy, three fifths of all the world's birds, has developed most strongly in relatively recent times. In an epoch when such ancient types as the ostriches, pelicans, cranes and others are on the way out, the passerines may well inherit the earth, or that fragment of it that man spares for them.

Although many systematists today regard the finches and sparrows as the most "evolved" of all the perching birds, the older ornithologists put the crows and jays at the top of the family tree. Perhaps they were right; certainly these resourceful birds are plastic, relatively unspecialized, opportunistic and probably capable of much further evolution—and that is what counts.

HOW THE WHITE TERN GETS ITS NAME

Classification is the sorting out of the different kinds of plants and animals into increasingly narrow categories: kingdom, phylum, class, order, family, genus and species. This process, which gives a special scientific name to every living thing, has many uses. For example, the bird on the cover of this book is sometimes called the white tern and sometimes the fairy tern in English. In other languages it has other names. But its scientific name, "Gygis alba," is an unmistakable label the world over and eliminates all confusion. Here is how the white tern is classified and its name derived:

KINGDOM: ANIMAL *(as distinct from plant)*

PHYLUM: CHORDATA *(animals with a dorsal supporting rod, the notochord. In most adult chordates, it is replaced by a backbone; these are the vertebrates)*

CLASS: AVES *(Latin for birds. Excludes other vertebrates like mammals and fishes)*

ORDER: CHARADRIIFORMES *(from a Greek word meaning birds that live in ravines or cliffs. Includes gulls, terns, auks, plovers)*

FAMILY: LARIDAE *(from the Greek word for gull. Includes gulls and terns)*

GENUS: GYGIS *(from the Greek for water bird. Includes one group of terns only)*

SPECIES: (GYGIS) ALBA *(from the Latin for white)*

In short: "Gygis alba," the white tern, with only the generic and specific names being used for its designation.

THE HORNED GREBE, A LOBE-FOOTED MARSH DWELLER, BELONGS TO A PRIMITIVE BIRD ORDER LITTLE CHANGED IN SOME 80,000,000 YEARS

The Living Birds

Descended 140 million years ago from reptilian stock similar to that which produced the dinosaurs, birds have radiated explosively over the earth. They show a wide variety of sizes, shapes, colors, and habits. They live in every continent and occupy almost every conceivable niche. Some even nest underground. All together there are 8,580 living species, plus a few dozen yet to be discovered.


Piciformes
Red-breasted Toucan
Trogoniformes
Quetzal
Columbiformes
Pintail Green Pigeon
Strigiformes
Spectacled Owl
Struthioniformes
Ostrich
Rheiformes
Rhea
Anseriformes
Mandarin Duck
Casuariiformes
Australian Cassowary
Apterygiformes
Kiwi
Galliformes
Golden Pheasant
Tinamiformes
Crested Tinamou
Charadriiformes
Pheasant-tailed Jacana
Sphenisciformes
Rockhopper Penguin