THE BIRDER'S BUG BOOK

GILBERT WALDBAUER

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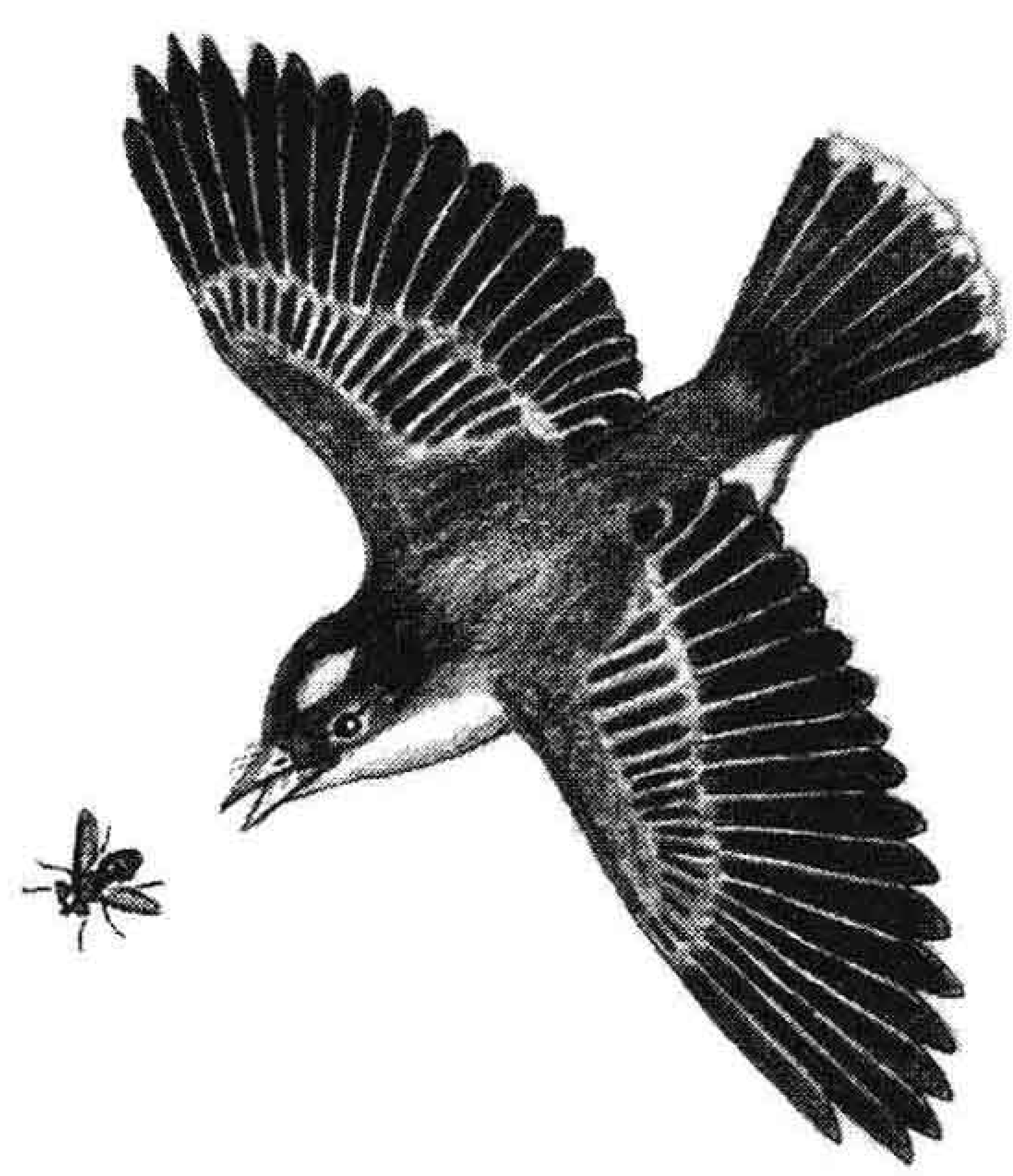

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To my beloved wife,
Stephanie Stiefel Waldbauer,
friend, valued adviser,
and discerning critic of my work

Preface

In 1944 I took Aretas A. Saunders's beginning biology course at Central High school in Bridgeport, Connecticut. I didn't realize it at the time, but he and his two biology courses (I took the advanced one the next year) were setting the future course of my life. Mr. Saunders was an accomplished naturalist and ornithologist, a leader of the movement to identify birds through binoculars rather than over the sights of a shotgun, an acknowledged authority on the calls and songs of birds, and author of the 1935 *Guide to Bird Songs,* a book that was *the* authoritative source before sound recordings came into wide use. On weekends he took me and my friend Robert Braun on birding expeditions to nearby areas. (Long trips were out of the question because of wartime gasoline rationing.) We visited Connecticut "hot spots" such as the Wood Duck Woods in Fairfield, the salt marshes at Westport, and the tidal flats near Norwalk.

Since my mother couldn't afford to buy me a pair of binoculars, I squinted at birds through a three-power "monocular," actually half of a pair of ancient field glasses that I had bought for fifty cents in a pawn shop. On one trip to the marshes at Westport, we were accompanied by Elting Arnold, who had come from Washington, D.C., to bird with Mr. Saunders. That day I saw my first yellow-crowned night heron, then a rare bird in Connecticut. Mr. Arnold noticed my "monocular" and apparently took pity on me, for a few weeks later Mr. Saunders passed on to me a package from Elting Arnold that contained a used but still very serviceable pair of 8 × 30 binoculars.

It wasn't long before I decided that I wanted to be a biologist, preferably an ornithologist. At the senior class graduation banquet, one of the students read aloud the "class will," which was actually a prediction of what would eventually become of the members of the class of 1946. The will was, at least in my case, amazingly prophetic. The reader intoned (the words are burned in my brain): "Gilbert Waldbauer, Professor of Entomology at Yale University, leaves a well-mounted tarantula to anyone who will have it." It seemed funny then, but I was a bit miffed. I wanted to be an ornithologist—not an entomologist and certainly not a professor. At that time I imagined, quite incorrectly, that professors spend all their days in classrooms and are seldom outdoors, where natural history actually happens.

But the class will was right and I was wrong. I did an undergraduate major in entomology at the University of Massachusetts in Amherst, but not until after a hitch in the U.S. Army that earned me the GI Bill credit that supported me as an undergraduate. I took the one ornithology course that was offered at UMass and thoroughly enjoyed learning the scientific foundation of the field. In the meantime, I had met Charles P. Alexander, head of the Department of Entomology and an outstanding researcher in the field of insect taxonomy. Professor Alexander was vibrant, very much interested in students, a knowledgeable all-round naturalist, and an exuberantly enthusiastic student of the insects. When I realized that he was willing to take me under his wing, I became his grateful protégé.

I soon began to think about a career in entomology. Insects were as fascinating as birds, and I envisioned a career devoted to research on the interrelationships between birds and insects, a hope that was ultimately realized. My thought eventually became a decision. I would become an entomologist. Professor Alexander assured me that my grades were good enough to qualify me for a teaching or research assistantship that would support me while I was a graduate student. He also told me that jobs were scarce for ornithologists but more plentiful for entomologists. After graduating from UMass, I entered the Department of Entomology at the University of Illinois in Urbana-Champaign as a graduate student and teaching assistant. I have been there ever since.

Off and on during my professorial career, I thought about writing a book on the many complex and interesting interrelationships between insects and birds. I envisioned a scholarly volume aimed at professional ecologists and evolutionary biologists and written in the inscrutable language of biology. I never wrote that book. When I retired from teaching, I decided that I would try to become a liaison between professional biologists and birders, other amateur naturalists, and anyone else interested in the interactions of animals. Thus I came to write *The Birder's Bug Book,* scientifically accurate but couched in language that avoids the professional jargon of biology insofar as possible.

But why write this book? The answer is that a bird—or any other organism—is best and most instructively viewed in the light of its ecological context, the plants, insects, and other organisms with which it associates. And as you will discover, insects are a significant and often hugely important part of the ecological context of most birds—as are birds an important part of the ecological context of insects. Trying to understand a bird or an insect taken out of its ecological setting is as unrewarding and futile as trying to see significance in a single word lifted from its context on this page.

This book is intended for anyone who is interested in natural history, especially for those who are interested in insects or birds. In my experience, almost all birders—even the most dedicated listers—view a bird as more than a checkmark on a list. They are curious about its life history and behavior, both of which may be largely determined by the insects that it eats and the insects that eat it. These birders, especially those interested in the conservation of bird species, want to know about the ecological context in which birds live. They know that birding becomes more and more enjoyable as we learn more about the birds that we see, and they also know that we cannot hope to save a species from extinction in the wild unless we understand it as a functioning member of its ecosystem.

The Birder's Bug Book

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Bugs and Birds through the Ages

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The tap-tap-tap of a downy woodpecker sounds crisply through the clear, cold air of a snowy woodland in New Hampshire. Late in summer, a house sparrow, feathers puffed out and partly folded wings fluttering, takes a dust bath in a small, dry depression beside a well-worn footpath in an Illinois farmyard, and in Tennessee an orchard oriole bends its head back as it rubs an ant against its flight feathers. On a prairie pond in Saskatchewan, a Wilson's phalarope spins around in tight circles as it swims in shallow water. In Africa, a small, sparrowlike bird approaches a honeybadger and entices it to follow, flitting from perch to perch as it gives distinctive calls. A starling in Michigan adds a sprig of fresh green leaves to its nest in an abandoned woodpecker hole. In Colorado an American dipper clambers over rocks beneath the surface of a fast-flowing stream, and in Connecticut an eastern towhee kicks noisily as it rummages among dead leaves in a woodland.

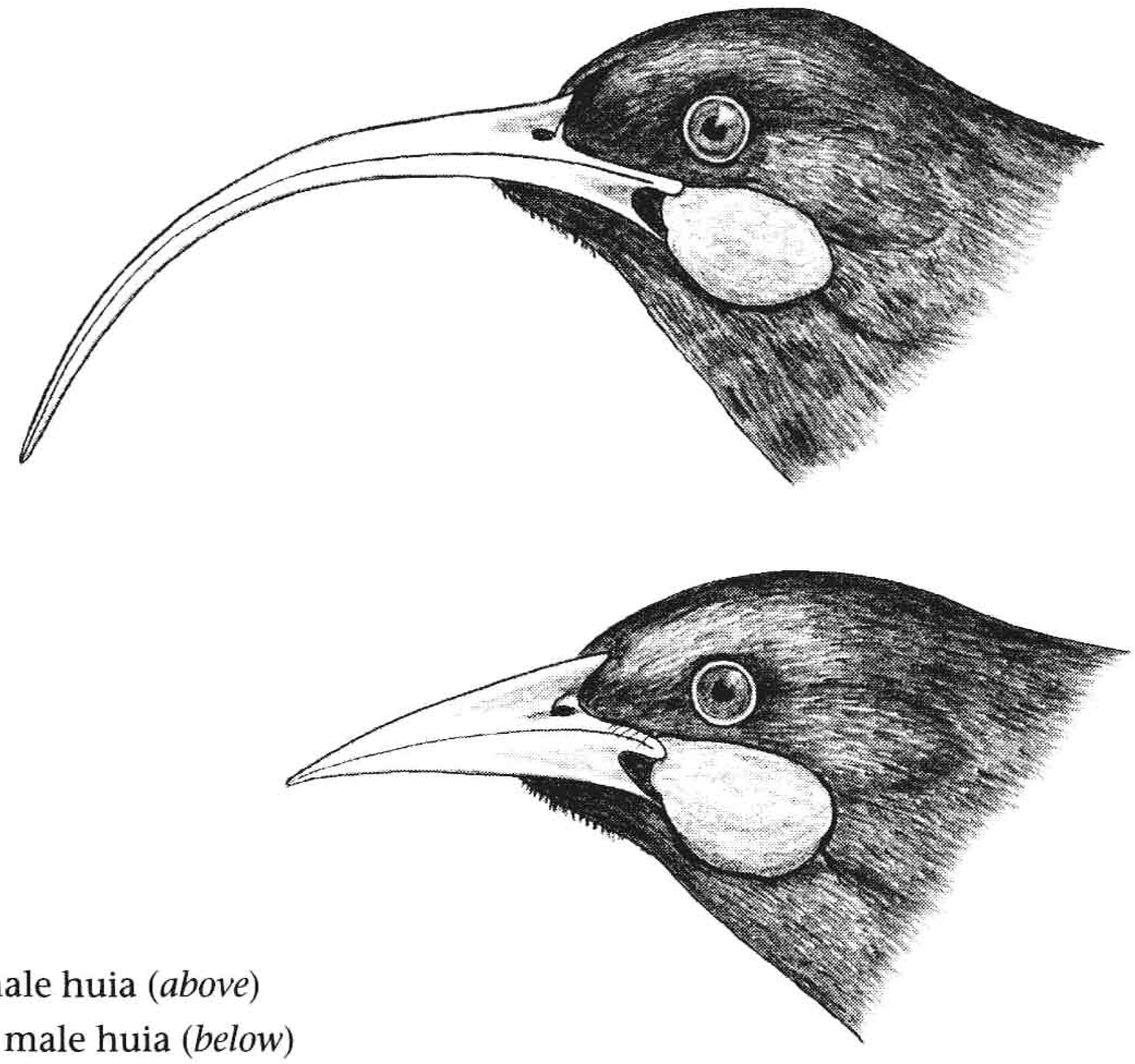
These seemingly unrelated activities have something in common: all stem from an association between birds and insects. The woodpecker eats the insects that it uncovers by chiseling through the bark of a tree. A dust bath may kill some of the lice that live on the house sparrow, and lice and mites that live among the oriole's feathers will be killed by formic acid or other toxic substances produced by the ant. The phalarope's gyrations stir up the bottom sediments and bring to the surface the aquatic organisms, including insects, on which it preys. The African bird, known as the greater honeyguide, leads the honeybadger, or even a person, to a colony of honey bees in a hollow tree and later eats the scraps of beeswax and honey that remain after its willing helper has broken open the tree to get at the honey. The fresh green sprigs that the starling adds to its nest contain chemicals that deter or kill parasitic mites. The dipper searches for a meal of aquatic

insects that cling to rocks in the stream, and the towhee eagerly snaps up the insects that it exposes by kicking aside dead leaves.

The relationships between birds and insects are ancient, and these often highly specialized interactions have become prominent and important facets of almost all continental ecosystems. Just try to imagine a woodland without its tanagers, flycatchers, vireos, warblers, woodpeckers, thrushes, nuthatches, and many other insectivorous or partially insectivorous birds. A woodland without insects would be bereft of these marvelous birds. There would be no swallows, swifts, or nighthawks wheeling in the sky if there were no "aerial plankton" for them to eat, the flying insects that they scoop up as they swoop through the air.

Through their specific associations, birds and insects have had significant and far-reaching effects on each other's evolutionary paths. The anatomy and behavior of many birds have been specially modified for the taking of their particular insect prey. Witness, for example, the flight of the whip-poor-will as its gaping mouth, widened by a fringe of bristles, traps insects from the night air; the antics of a red-billed oxpecker as it plucks ticks from the skin of an African rhinoceros; the nervous movements of a wood warbler as it uses its tweezerlike bill to pick small caterpillars and other insects from the leaves of a tree; and the darting flights of an olive-sided flycatcher as it sallies forth to use its snap-trap bill to intercept flying insects that it spied from its perch at the top of a balsam fir. Insects have, in turn, responded to the depredations of birds by evolving a variety of defensive tactics, ranging from exquisite camouflage and swift flight to the venomous sting of a bee or the vomit-inducing properties of a monarch butterfly. Most venomous or toxic insects have bright, easy-to-remember color patterns that birds and other insectivores can readily learn to avoid, a fact that makes it possible for some harmless insects which lack defenses of any sort to escape predators by bluffing, by mimicking the color patterns and even the behavior of insects that do have defensive weapons.

The wood-probing, insect-eating huia of New Zealand is an avian example of extreme anatomical and behavioral specialization for the capturing of insect prey. The huia, last seen in 1907 and now extinct, was unique among the birds of the world, because of the radically different bills of the two sexes. The straight, stout bill of the male was less than half the length of the slender, decurved bill of the female. According to the New Zealand



The female huia (*above*)
and the male huia (*below*)

ornithologist Walter Buller (see E. G. Turbott's annotated edition of Buller's 1883 book), foraging by huias was a cooperative effort between the male and the female, with their different bills complementing each other. Buller described how a captive pair, which seemed to be inseparable, attacked a decaying log to obtain their favorite food, larvae of the huhu, a very large, wood-boring, long-horned beetle. Having noted that their behavior seemed to show the "usefulness of the differently formed bills of the two sexes in the economy of nature," he went on to describe how the huias responded to a rotting log that he placed in their cage:

> They at once attacked it, carefully probing the softer parts with their bills, and then vigorously assailing them, scooping out the decayed wood till the larva or pupa was visible, when it was carefully drawn from its cell . . . and then swallowed. The very different development of the mandibles in the two sexes enabled them to perform separate offices. The male always attacked the more decayed portions of the wood, chiselling out his prey after the manner of some Woodpeckers, while the female probed with her long pliant bill the other cells, where the hardness of the surrounding

> parts resisted the chisel of her mate. Sometimes I observed the male remove the decayed portion without being able to reach the grub, when the female would at once come to his aid . . . I noticed, however, that the female always appropriated to her own use the morsels thus obtained.

Not only do birds exploit insects, but insects exploit birds. The arrival of birds on the evolutionary scene provided a new resource for insects. Nature abhors a vacuum, including ecological vacuums, and insects soon began to take advantage of this new resource. Modern insects have, through the evolutionary process, come to exploit birds in many ways. Some, such as certain kinds of mosquitoes, visit birds from time to time to suck blood, the source of the protein needed to develop their eggs. Other insects and many mites, tiny, eight-legged relatives of the insects, live in the nests of birds—some acting as scavengers of dead organic material and others attacking the nestlings or even the adults. Some fleas live in the nests of birds throughout their lives. The legless larvae eat organic debris, and the wingless adults, which lay their eggs in the nest and may spend much of their time there, use their jumping legs to leap onto the body of the resident bird when they require a blood meal. Some insects, such as the biting lice, have lost their wings and live permanently as parasites on the bodies of birds. They usually die when the host bird dies and can transfer from one bird to another only when birds are in close bodily contact. Some of these lice are generalists that can live on many different kinds of birds. Others have become so specialized that they can live only on one species of bird or on a few closely related species. If a specialist louse is artificially transferred to a bird other than its usual host, it will refuse to eat and soon will die.

It seems inevitable that many birds have come to depend upon insects as food and that some insects have evolved to exploit birds as food. After all, insects occur, usually in large numbers, almost everywhere that birds occur—all over the world except on the Arctic and Antarctic icecaps. But they are surprisingly abundant in the parts of the Arctic that are not permanently covered by ice, and some occur even in the few wind-blown, ice-free areas of the Antarctic. They are very rare in the seas, but mosquitoes breed in brackish seashore pools, and marine water striders skate on the surface of the ocean hundreds of miles from shore.

The diversity of insects is mind-boggling. Of the approximately 1.2 million animal species now known, about 900,000—75 percent—are insects, and there may be several million insects that have yet to be discovered. The beetles alone number 300,000 known species, and are thus more than five times as numerous as all of the vertebrates put together—the fish, amphibians, reptiles, birds, and mammals.

Insects are also numerous as individuals. In Pennsylvania, a square foot of forest leaf litter and humus examined in the 1940s contained almost 10,000 arthropods, including nearly 7,000 mites, almost 3,000 insects, and a few other arthropods such as centipedes and millipedes. The insects on an African savanna outweigh the large grazing animals on a per-acre basis, and in an abandoned, weed-grown crop field in North Carolina surveyed in the 1960s, the plant-feeding insects alone outweighed all the sparrows and mice by a factor of nine. A single honey bee colony may contain more than 50,000 workers, and a tropical termite colony may include well over 1 million individuals.

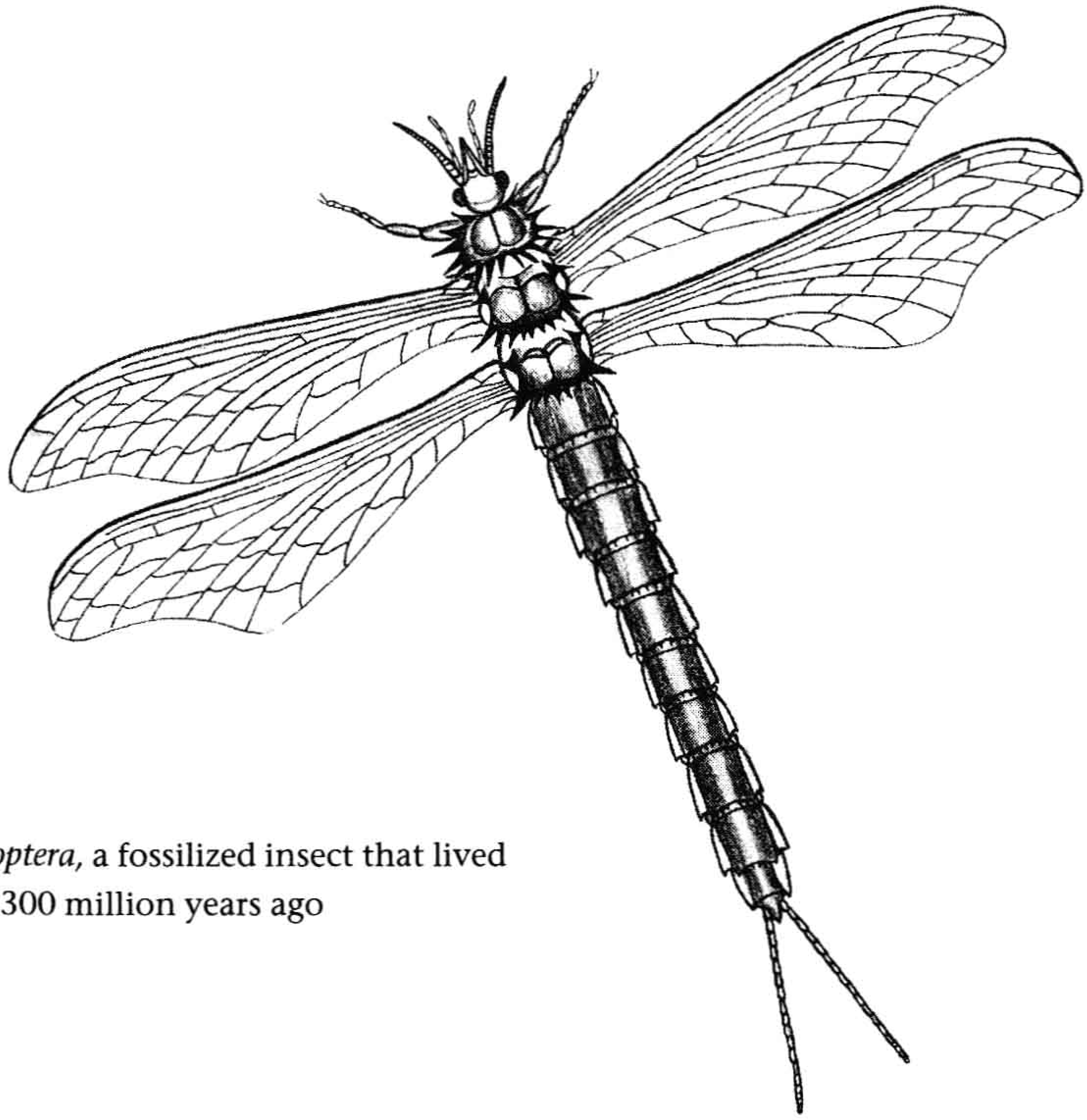
Insects derive a living from their many habitats in almost every imaginable way. In the aggregate, they feed on almost all of the 250,000 known plant species. Some serve the plants as pollinators, and others consume leaves, fruits, roots, or even the woody stems. Other insects eat carrion or dead vegetation. Many attack insects and other animals: some as blood feeders; some as predators, especially of other insects; and a sizable group as parasites of earthworms, other insects, birds, mammals, and other creatures.

Because of their diversity and abundance, insects are important and usually indispensable parts of almost all the terrestrial and freshwater ecosystems on earth. Consider only insects that pollinate plants. Without them, tens of thousands of plants would become extinct or survive only as remnant populations. The land would be dominated by pines, firs, grasses, and a few other wind-pollinated plants such as cottonwoods and ragweeds. If we consider only sweet fruits that people eat, without pollinating insects there would be no melons, figs, peaches, plums, apricots, cherries, strawberries, raspberries, blackberries, blueberries, cranberries, kiwis, citrus fruits,

pears, or apples. And if we consider that insects perform many essential functions other than pollination, it becomes apparent that without insects most of the ecosystems of the continents would collapse and be replaced by degraded ecosystems that would be far less hospitable to humans, birds, and most of the other forms of life that have thus far evolved.

The insects are the greatest evolutionary success story of all time. Millions of years before the first bird evolved, they had already spread throughout all the continents. The first primitive insects, wingless, crawling creatures, appear in the fossil record about 400 million years ago during the age of fishes, when the earliest amphibians were venturing onto the land—long before the first reptile or mammal had evolved, and even longer before the first bird appeared in the fossil record. Winged insects first appear 65 or 70 million years later, about 330 million years ago during the Carboniferous Period, the heyday of the great coal forests, the age of the amphibians, and the time of the appearance of the very earliest reptiles. By about 250 million years ago, when the ancestral Appalachian Mountains were being formed, when the first dinosaurs appeared, and long before the birds evolved, the insects were already an ancient group, many of whose major subdivisions (orders) were already present, including quite a few that are familiar to us today, such as dragonflies, crickets, true bugs (the members of the order Hemiptera), and beetles. The wasps, bees, and butterflies appeared much later.

Insects are relatively rare in the fossil record, less numerous than the bones of vertebrates, the shells of mollusks, or even the soft bodies of some marine invertebrates. Most insect fossils are fragmentary, often no more than a wing, but a few—especially some in amber or fine-grained shales—are complete and surprisingly well preserved. There were giant insects during the Carboniferous Period: dragonflies and mayflies with wingspans of 28 and 18 inches, respectively, and a formidable piercing and sucking species that belonged to a now extinct order and had a stout, inch-long beak and a 22-inch wingspan. The best preserved insect fossils are embedded in amber, the fossilized resin of pines and other trees. Many are in astonishingly good condition—every bristle in place and looking as if they had died just yesterday. The Baltic amber of Europe, used in jewelry for thousands of years, is justly famous for its insect inclusions, but amber containing insects is also found in a score of other sites in Asia, Europe, North



Mischoptera, a fossilized insect that lived about 300 million years ago

America, and the Caribbean. The oldest known ant, contemporaneous with dinosaurs, was preserved 100 million years ago in a lump of amber found in New Jersey in 1966. Insects in Baltic amber, only about 40 million years old, look familiar and are very similiar to modern species, but older amber, such as that from New Jersey, contains insects that are obviously different from modern species.

As you already know, birds evolved much more recently than the insects. The first animal with undisputed feathers does not appear in the fossil record until about 150 million years ago, during the Jurassic Period, when huge dinosaurs roamed the earth, when conifers and palmlike cycads were the dominant land plants, and before the angiosperms, or flowering plants, had evolved. This crow-sized creature had many small, sharp teeth, feath-

ered wings, and a long tail with the feathers arranged along its sides as the "leaflets" of a fern are arranged along the stem of the frond. In 1862, this creature was named *Archaeopteryx* (from the Greek roots *archeo,* ancient, and *pteron,* wing) by the German scientist Hermann von Meyer. Some modern authorities consider *Archaeopteryx* to be a bird while others think of it as a feathered reptile, but most agree that it is an ancestor or a close relative of the ancestor of modern birds. (Although there were once pterosaurs, flying reptiles, they were certainly not the ancestors of the birds. Their wings, rather than being feathered, were membranous like those of a bat.)

The fossils of *Archaeopteryx* were found in Bavarian quarries from which exceedingly fine-grained Jurassic limestone is mined for use as lithographic slabs. The first one found is an impression of a single feather, but since then six others have been discovered. Some of these fossils are fragmentary, but one that is in the Humboldt Museum für Naturkunde in Berlin is beautifully preserved. As the illustration on the facing page shows, there are unmistakable imprints of feathers, and the skeleton is virtually complete and fully articulated.

There are two theories of the evolutionary origin of the birds. One is that they descended directly from early reptiles, the thecodonts, which also gave rise to the crocodilians and the dinosaurs. This theory places the origin of the birds about 230 million years ago in the middle of the Triassic Period. The opposing and most generally accepted theory is that the birds did not stem directly from the thecodonts, but that they arose much more recently, somewhat more than 150 million years ago, during the Jurassic Period, from dinosaurs that descended from the thecodonts. According to the latter theory, the birds began with *Archaeopteryx* or some similar creature. The theory of the Triassic origin of birds leaves a difficult-to-explain gap of 90 million years between the presumed origin of the birds and the appearance of *Archaeopteryx*. Some think that a fossil recently found in Texas closes this gap, since it is 75 million years older than *Archaeopteryx*. Originally considered to be fragments of a bird, it was named *Protavis,* but many authorities now think that the condition of this fossil is so poor that it cannot be shown to represent a bird. It is fragmentary, includes no feather imprints, and when found consisted of a jumble of broken and unarticulated bones. There is no doubt that birds descended from reptiles, but whether they arose from dinosaurs or earlier reptiles is being hotly debated. So far there is