TALES FROM THE ANT WORLD

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INTRODUCTION: ANTS RULE

EVERYONE LIVING OUTSIDE the polar ice sheets who has gazed around their own feet has seen ants, and inevitably, they have heard tales about these social creatures, especially concerning their relationship with humanity. Ants, it is said, are among the little creatures that run the world, perhaps for our benefit, or perhaps not. Ants form societies that rival roughly in form and variety those of human beings. Then, there is their awesome abundance. If *Homo sapiens* had not arisen as an accidental primate species on the grasslands of Africa, and spread worldwide, visitors from other star systems, when they come (and mark my word, they will eventually come), should be inclined to call Earth "planet of the ants."

I've written *Tales from the Ant World* from the experience of a lifetime, some eight decades, of studying fabulous insects. I began in grammar schools in Washington, DC, and Alabama, and continued, with the same emotions, to university research professor and curator of entomology at Harvard University. In these *Tales,* I convey some of the importance of what I have learned from my studies and those of others. Incidentally, I and my colleagues are called myrmecologists in the scientific academy. And even though I have now written over thirty books, most of them scholarly, I have not until this book told the amazing stories

of myrmecology as a physical and intellectual adventure—if you will, an adventure story.

I am especially hopeful that this account will reach students—even ten years old is not too young—interested in the prospect of a scientific career. The subject at hand is wide open. The existing natural history and biology of ants covers only a tiny fraction of the more than 15,000 ant species discovered to date, given a name, and studied carefully. And beyond the ants, more than a million species of insects, spiders, and other arthropods await full attention. The more that this part of the biosphere is studied by future experts, the better off will be the world, ourselves included.

Meanwhile, the most frequent question I am casually asked about ants is, "What do I do about the ones in my kitchen?" My answer is, Watch where you step, be careful of little lives, consider becoming an amateur myrmecologist, and contribute to their scientific study. Further, why should these wondrous little insects *not* visit your kitchen? They carry no disease, and may help eliminate other insects that *do* carry disease. You are a million times larger than each one. You could hold an entire colony in your cupped hands. You inspire fear in them; they should not in you.

I recommend that you make use of your kitchen ants by feeding them and reflecting upon what you see, rather like an informal tour of a very foreign country. Place a few pieces of food the size of a thumbnail on the floor or sink. House ants are especially fond of honey, sugar water, chopped nuts, and canned tuna. A scout in close vicinity will soon find one of the baits and, to the degree the colony is hungry, run excitedly back to the nest. There will follow social behavior so alien to human experience that it might as well be on some other planet.

TALES FROM THE

ANT WORLD

1

OF ANTS AND MEN: MORALITY AND TRIUMPH

I'LL BEGIN THIS myrmecological tour with a word of caution. There is nothing I can even imagine in the lives of ants that we can or should emulate for our own moral betterment.

First, and most importantly, all ants active in the social life of colonies are females. I am an ardent feminist in all things human, but in ants one has to consider that during their 150 million years of existence, gender liberalism has run amok. Females are in total control. All ants you see at work, all that explore the environment, all that go to war (which is total and myrmicidal) are female. Adult male ants are pitiful creatures by comparison. They have wings and can fly, huge eyes and genitalia, and small brains. They do no work for their mother and sisters, and have only one function in life: to inseminate virgin queens from other colonies during nuptial flights.

To put the situation as simply as possible, males are little more than flying sperm missiles. Once launched, they are not allowed to reenter their home nest, though if successful they may become

fathers of new colonies comprising, in some species, many millions of daughters and sons. Whether successful or not at reproduction, they are destined thereafter to die within hours or at most a few days from rain, heat, or the jaws of predators. They cannot just stay at home. They do no work there and are otherwise a burden on the colony. After the nuptial flights, should they linger they are driven out by their sisters.

Second on the list of formicid moral precepts, after absolute female rule and much more horrific, many kinds of ants eat their dead—*and* their injured. If you are an elderly or disabled worker, you are programmed to leave the nest and not burden the society any further. If you die while in the nest, you will be left where you drop, even on your back with all six legs sticking up in the air, until your body emits the odors of decomposition, which are, in particular, oleic acid and its oleates. When you smell dead, your body will be carried to the colony refuse pile and dumped. Or, if just mangled and dying, you will be eaten by your sisters.

In a third morally dubious propensity, ants are the most warlike of all animals, with colony pitted most violently against colony of the same species. Extermination is the goal for most, and as a rule larger colonies defeat smaller ones. Their clashes dwarf Waterloo and Gettysburg. I have seen battlefields strewn with dead warriors, a high percentage of which, as it turns out, are aging females. As adult workers grow older, they take on increasingly dangerous activities on behalf of the colony. At first, most serve as attendants of the queen mother and her brood, from eggs to larvae and through pupae to newly emerged adults. Next they engage more in nest repair and miscellaneous other internal tasks. Finally, they become prone to service outside the nest, from sentinel to forager, to guard, to warrior. In a nutshell and put more plainly, where humans send their young adults into battle, ants send their old ladies.

For ants, service to the colony is everything. As individual workers approach natural death, it benefits the colony more for the old to spend their last days in dangerous occupations. The Darwinian logic is clear: for the colony, the aged have little to offer and are dispensable.

Evolution at the level of organized groups has paid off richly for the more than 15,000 species of the world's ant fauna. Ants are the dominant land carnivores in the weight range of one to one hundred milligrams. Termites, sometimes erroneously called "white ants," are the dominant consumers of dead wood. Together, ants and termites are the "little things that run the world," at least among the animals of the terrestrial world. In the Brazilian rain forests, for example, they make up an astonishing three-quarters of the insect biomass and more than one-quarter of the entire animal biomass.

Ants have been prominent on Earth over one hundred times longer than have humans. They are estimated (by molecular methods) to have originated about 150 million years ago. They then diversified into myriad anatomical forms 100 million years before the present, by the end of the Age of Reptiles. A second such radiation occurred during the early Age of Mammals. The modern species *Homo sapiens*, in contrast, emerged in Africa only one million years ago, a fraction of that time.

Had extraterrestrials visited Earth at any random time during the past hundred million years, they would have discovered abundant life clothing the land. They would have found the fauna and flora dominated by ants and thereby, in part, healthy and intact. The extraterrestrials would have become myrmecologists. They would find ants, as well as termites and other highly social creatures, somewhat bizarre, yet for that reason a key force in sustaining stability in almost all the terrestrial ecosystems of the planet.

The extraterrestrials might then report to their home planet, concerning Earth, “All is in order. For a while.”

2

THE MAKING OF A NATURALIST

NATURE IS THE metaphorical goddess of all existence that lies beyond human control. Humanity is blessed to the extent we love her, and her products, from the sweet descent of her sunsets to the tantrums of her thunderstorms, and from the empty vast space beyond her biosphere to the seething diversity within it, of which we ourselves are a recent chance addition.

The love of Nature is a form of religion, and naturalists serve as its clergy. The goddess, we believe, will lead us from the darkness into light. For those who follow, she has made the ultimate promise of all religions: grant Nature eternity on this planet, and we as a species will gain eternity ourselves.

My own life is the result of an early blend of the two faiths, the first traditionally pious and the second scientific. I consider myself fortunate, in that during the years I spent laboring through public schools, I spent most of my time preparing for a career in natural history. I wanted within all my dreams to be a professional naturalist. I never gave any other option a second thought. As a result I paid little attention to classwork, sports, and social activity.

This slighting of normalcy was due in part to the odd circumstance that I was the only child of four parents, attended sixteen schools across eleven grades in as many towns and cities, and was subject while growing up to the confusion this multiplicity inflicted. My father, Edward, Sr., and my mother, Inez, divorced when I was eight years old. During this drama, unusual for the 1930s, I was parked for a term in the famously strict Gulf Coast Military Academy, since closed. I was next placed in the paid care of a grandmotherly lady, Belle Robb ("Mother Robb"), who was wonderfully kind to me. She was also an excellent cook, notably for her uniquely tasty fried grits cakes. Mother Robb was the best of all possible child guardians, from a young boy's point of view: she let me do mostly what I pleased. There was one exception: that I take an oath to God that I would never drink alcohol, smoke, or gamble. And, above all, I must swear to love Jesus with all my heart and soul. Our Savior, she assured me, would return personally to visit me once in a while. When I grew impatient waiting for the physical Jesus, Mother Robb conceded that He might appear as no more than a flash of light in some place like an upper corner of my room.

In time, the failure of a personal Second Coming didn't matter. I had developed other interests. With Mother Robb's encouragement, I made a collection of every kind of insect I could find around the neighboring houses, in the vacant lots, and along the streets from the Robb home at 1524 East Lee Street, Pensacola, Florida, thence to the local grammar school I attended. It was an exciting adventure for a child my age, one I still pursue on a larger scale, and a forerunner of an important data-gathering procedure in modern ecology, the All Taxa Biodiversity Inventory (ATBI). I watered tropical plants Mother Robb kept on the porch and everywhere throughout the house. I fed my pet baby alligator, and began digging a hole in the backyard I hoped would take me all the way to China.

But beyond being a typical boy, my most influential activity was made possible by a Christmas gift from my mother: a child's compound microscope. With this instrument I spent hours watching rotifers, paramecia, and other microscopic organisms abundant in drops of pond water. This adventure was to work a powerful influence on me for the rest of my life. I have never changed: I experience a similar thrill whenever I visit unfamiliar habitats in different parts of the world in search of new kinds of plants and animals.

In 1939, when I was ten years old, I left Mother Robb and Florida and rejoined my father, by then a government employee with a new wife, my stepmother Pearl, to live in an apartment on Fairmont Street in Washington, DC.

It was one of the happiest chance events of my life. I found myself now living only five city blocks from the National Zoological Park, informally called the National Zoo. Just beyond this wonderland, filled with large animals from around the world, lay the woodland and pastures of Rock Creek Park.

Inspired by field guides and dazzling photographs in library issues of *National Geographic*, free entrance to the National Zoo, and the wilds of Washington, DC, to explore, I became a fanatic about butterflies. By taking time out from schoolwork, I was able to build a large collection. My main instruments were pins and specimen boxes, and an insect net made for me by Pearl. (In later years and new adventures, I found it easy to make a net quickly, anywhere. Take a sawed-off broomstick for a handle, bend a coat hanger to form a circle and attach it to the handle, and sew cheesecloth into a bag hung from the coat hanger rim.) I became adept at locating and netting almost all the many species that fly within and around our nation's capital. And to this day, I remember them all in vivid detail. There were fritillaries abounding in front yard gardens, red admirals chasing one another in territorial battles back and forth

around parked cars, tiger swallowtails speeding overhead, what may have been a giant swallowtail (but flew into a tree canopy and eluded me), countless sulfurs, blues, hairstreaks, cabbage whites, and (a triumph!) one specimen of the native white species. I sought but had not a single glance of the mostly winter-dwelling mourning cloak.

Give me today a butterfly net and a spring and summer in the nation's capital (and a letter to show the DC police) and I believe I could happily repeat my adventure.

My fascination with the natural world began to spread with time and more subjects and places to explore. I was aided by my best friend, Ellis MacLeod, who twenty years later would become a professor of entomology at the University of Illinois (at the same time I received a similar appointment at Harvard). As boys together we took an interest in ants. The source of our inspiration was a *National Geographic* article entitled "Ants: Savage and Civilized," by William Mann, the director of the National Zoo at the very time I was making frequent visits to see the large animals and net butterflies in the Zoo's gardens. To continue the coincidences, Mann had earlier earned his PhD under William Morton Wheeler, professor at Harvard, and my predecessor as curator of entomology and builder of the ant collection (with Mann's help) of Harvard's Museum of Comparative Zoology.

In "Ants: Savage and Civilized," Mann gave an account of species found in mostly tropical countries. It soon dawned on us ten-year-olds, Ellis and me, that the only ant he depicted that we could hope to find in Washington, DC, was the "Labor Day ant" (scientific name *Lasius neoniger*), whose small crater nests abound in yards, gardens, and golf courses throughout almost the whole of the eastern United States, and whose common name derives from the swarms of males and virgin queens emerging to mate following a heavy rain within a week or so around Labor Day.

This nascent interest was then cut short. After two years' residence in Washington, DC, our little family migrated back to Mobile, Alabama. It was home, where almost all of my father's ancestors had lived since the 1820s. My paternal grandmother, Mary Wilson, had died, leaving my father and his brother, Herbert, the large house built by my great-grandfather.

Fortunate once again, I found myself a short distance from unusually rich natural environments, this time overgrown vacant lots along with the remnant marshes and woodlots lining the dock area of Mobile Bay. With a new, balloon-tired Schwinn bicycle, I could easily reach a rich mix of wild and semi-wild habitats as far as the Dog River and Fowl River crossings, on the road to Cedar Point, and at the end an unpaved road to the dock for transport to Dauphin Island. My experiences with butterflies and ants deepened, and my interests broadened to include many other kinds of insects. There was also my newest love, the snakes and other reptiles that abound in variety along the coast of the Gulf of Mexico.

My general drift toward becoming a naturalist was deepened and set firmly by yet another emigration, this time to the little Alabama town of Brewton, located close to the Florida Panhandle border just north of Pensacola. Bucolically pleasant in both its people and dwellings, with a population stable at about 5,900, surrounded by "swamps"—floodplain forests dissected by freshwater streams—it is part of the central Gulf Coast region recognized today as having possibly the richest terrestrial animal diversity in North America. Therein dwell thirty-two species of snakes; fourteen species of turtles (a fauna rivaled only by the Mekong delta and parts of the Amazon watershed); dramatic arrays of freshwater fishes, crayfishes, and mollusks; plus everywhere seemingly boundless ants, butterflies, and other insects.

Decades later, I used Brewton as my model for Clayville, an imagined Southern town, in my novel *Anthill*. (This work, to my pleasant surprise, was given the 2010 Heartland Prize, for best novel on American life.) Brewton, for its part, rewarded my admiration by naming a nature park after me. The reserve is relatively large, stretching from within the town limits in one direction toward Burnt Corn Creek, where during the War of 1812 Red Stick Creek warriors defeated a contingent of Alabama militia, and in another direction toward Murder Creek, where bandits robbed and killed a group of early Brewtonians on their way to Pensacola to purchase bullets.

I gained some credence among my teenage peers by being the first Boy Scout in the surrounding area to earn the rank of Eagle. Also, for sitting on the bench as the third-string defensive end of the football team. (I was called to play only once, in the final minute of the winning final game, with the proudly remembered words, "Wilson, take left end.") And finally, for hand-capturing venomous cottonmouth snakes and exhibiting them to my fascinated peers. (The Wilson method, which I recommend here only for the experienced adult, is the following: let the snake start to move away from you, pin it with a sawed-off broomstick as safely as possible, close to the head, roll the stick forward to pin the entire head firmly, pick up the snake just behind the head, raise the entire snake with your loose hand and drop it into an already opened sack.) Amid boys my age with nicknames like A.C., Chip, Buzz, and Rusty, I was rewarded with one of my own, Snake. This was all a "Southern thing," as they say. The same epithet was later earned by a professional football running back for his skill at weaving through lines of the defending team.

3

THE RIGHT SPECIES

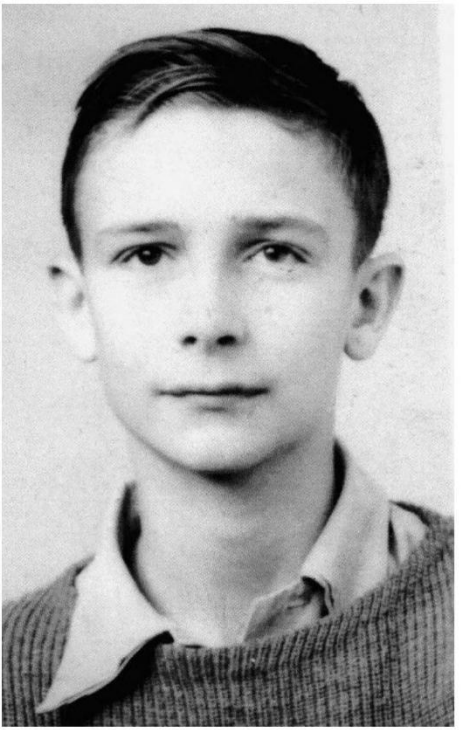
IN THE SUMMER of 1945, shortly after my sixteenth birthday, my father moved our little family from Mobile, Alabama's coastal city, 337 miles north to Decatur, where the Tennessee River crosses the north-central tier of Alabama counties. There, within and all around the little port city, a new natural world opened up to me. It would have an especially profound effect on my life and scientific career.

Edward, Sr., was a professional traveler, a financial auditor for the Rural Electrification Agency, which supplied electrical power to towns and farms across the rural South. In order to stay close to both work and home, he chose to move our residence every several years.

One result of our peregrine existence was that during my public education I attended fifteen schools in sixteen towns and cities in three states plus the District of Columbia.

A schedule of this withering complexity can be rough on an adolescent. I adapted by turning even farther toward Nature. Where I found it difficult to make new friends, and thereby gain

entry into the usual teenage friendships, cliques, and athletic teams, I turned instead to natural habitats to find a reliably familiar environment.



Ed Wilson at 14, in his butterfly, dolichopodid fly, and snake period, before switching to ants as the favored group.

Hence I spent summers mostly on my bicycle, searching for scraps of wild environment that had survived within and around Decatur and beyond, into the copses and old-growth fields. The wildest places were across the Tennessee River, many abandoned during the Second World War, which still raged abroad. I seldom saw another person, and then only at a distance.

On the Decatur side I discovered a natural cave, and despite a mild case of claustrophobia explored it in search of blind, white

crayfish and other troglobites, as such underground specialists are scientifically designated. Fortunately I never lost my way in the cave. No one would have known where to look for me until my bicycle was noticed outside the cave entrance. But I was never lost, at least for no more than a few hours, and never have been while exploring other wild environments.

Today, writing seventy-five years after my arrival in Decatur, I perceive it as fortunate that I took little interest in making friends or in any way being popular or even winning acceptance in the social life of the Senior High School. My paramount and almost exclusive ambition was to become an expert in some aspect of natural history, and to learn the science supporting it. I was preparing for a university education. My room in Decatur was filled not only with standard high school references and textbooks but with field guides to the plants and animals of North America.

Literally millions of species existed around the world in natural environments, and still do thus far into the twenty-first century. The study of any one species, I understood, could provide the beginning of a scientific career. The challenge to me in my teens, as it is for most acolytes of my kind, was not to discover the best way to study any particular chosen species or cluster of species. Rather, it was to choose the *right* species. I understood that if I chose wisely, my career as a scientist could begin as early as my first year of college.

I needed courage and ambition to get started. The very idea of higher education was daunting, especially since I would be the first in the history of my family on either my father's or mother's side to attend college. Furthermore, money was scarce. My father was ailing, a result of his service in World War I; it was in the army that he learned his trade as an accountant. Given that he had received no more than a seventh-grade education otherwise, I came to admire him for the steep hill he climbed to achieve his profession

in life. His example gave me added strength in my determination to do whatever it took to become a professional scientist and naturalist. I thought I needed to go to a university, although in later years I became persuaded that a good liberal arts college probably would have done as well.

I was especially attracted to the scholarship program at Vanderbilt University, advertised during my senior year of high school in Decatur, as it seemed conducive to my ambition. I even took an examination the university had supplied. I tried hard, but was not awarded a fellowship or even an unaided admission. Many years later I mentioned my failure, without malice, when I gave the inaugural address at the opening of Vanderbilt's new Science Center.

Like millions of other youngsters in America, I came to realize that my only resource for attending college would be the meager amount my parents could provide, plus whatever I could earn and save on my own. So during my senior year of high school I took whatever job I could find and saved my earnings. I moved from one to the other to make the most: a paper route, next a door-to-door magazine salesman, then a soda jerk in a five-and-dime store, a stock clerk in a department store, and finally, an office boy in the local steel mill. I was desperate to succeed, and I did well. When at the end of the summer of 1946 I prepared to leave the steel mill, the manager of the division I served said, "Ed, you don't have to go to college. Stay here at the mill. You have a high school diploma! You'll go far."

I decided not to discover how far. In any case, the Alabama legislature saved me. At least, its members took action that accidentally admitted me to the University of Alabama. They evidently foresaw that campuses, with the end of World War II and passage of the GI Bill guaranteeing college-level educational support for those who had served, would be swamped with

returning veterans. They passed a law directing that anyone who was a resident of the state and a high school graduate would be admitted to the University of Alabama. I was not a veteran, but I passed the other two basic requirements, and upon application was admitted to the state's premier university. It should be no surprise to anyone that to this day I have remained one of the University of Alabama's most loyal alumni, in every way possible.

Now came the big choice. With the University of Alabama in my future, what should be the insects—whether a group of related species or just a single species—on which I could become the world authority, and thereby launch my career as a scientific naturalist? I made field trips into the fauna and flora all around Decatur. I fished in the nearby Tennessee River, memorized the names of every local fish species, from perch to alligator gar, hunted for snakes in the local woodlands, searched in my nearby cave for blind white beetles and iron-like mandibulate carnivorous crickets. And I undertook on my own a college-level study of insects in general.

An early candidate was a bizarre set of species that forms small ecosystems likely to date back in prehistory for hundreds of millions of years. Sponges are everywhere in the world, primarily as dwellers of shallow seas, but here and there can be found species that live in freshwater streams and lakes. In one pristine brook on the edge of a farm I found colonies growing in thick beds on the bottom. They formed a unique ecosystem, with evidence of damage from caterpillar-like insect larvae with the common name spongillaflies, also of ancient origin. Sponges and their parasite flies: amazing! But I decided not to choose sponges and spongillaflies as my favored group for study in college and beyond. They are rare, and obviously hard to find just anywhere.

Not so dolichopodid flies, the "long-legged ones" as their Latinized name translates. I found them everywhere in gardens,

and they were hard to miss, their tiny bodies turned by the refraction of sunlight into particles of metallic greenish gold as they zigzagged and spun in circles on leaf surfaces, lifted high like dancers on long legs too slender to be seen by the naked eye. The Dolichopodidae are not your usual flies—in the common perception, repulsive seekers of filth and carcasses—but rather, shining clean predators of other insects their size and smaller.

Ed Wilson at 17, on the day of arrival at the University of Alabama, September 1946.

I learned by reading that over five thousand dolichopodid species were known by science from around the world, with many more waiting to be discovered and described. Their biology remained largely unstudied. Here, it seemed, was a subject worthy of lifetime scientific study, awaiting specialists to understand and make it known. I could picture myself in future years: Edward O. Wilson, expert on the dolichopodid flies, position as dipterist in the Smithsonian Museum, expeditions planned with net and bottle to the Amazon, to Patagonia, to the Congo . . .

But then, I discovered something even more exciting. Or, providentially, they discovered me. Ants, as I will next explain.

4

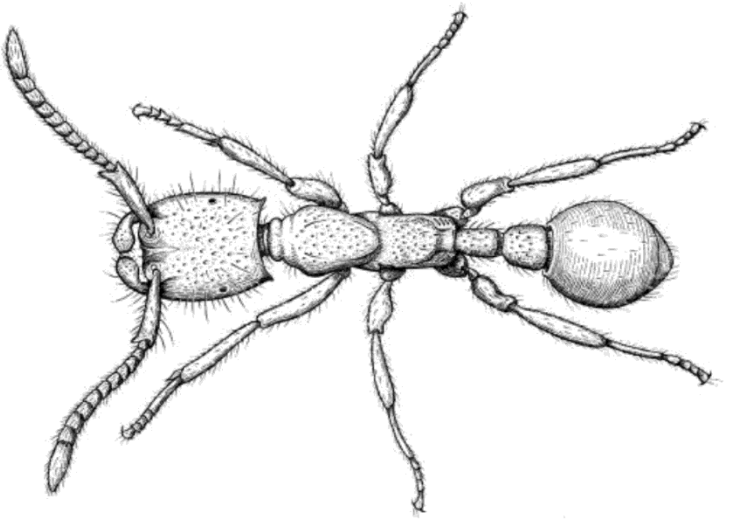
ARMY ANTS

THE COLONY POURED out of a hidden bivouac into our backyard, a horde the size of a dozen Roman legions, forming a line three or four abreast. They were army ant workers and soldiers: upward of one hundred thousand strong, accompanied by their thimble-sized mother queen, on the move hard and fast from an old stronghold to a new. Each ant ran double-time, following a chemical trail laid by scouts ahead, hemmed in by her sisters front, back, and to the side. The whole colony emerged from the bivouac into the yard like the uncoiling of a rope.

Walking along the marching column, I came to the end, and another surprise: The rear guard consisted not of ants but of small beetles and silverfish. These camp followers, which, in time I found, characterize army ant colonies of all kinds, are social parasites. Eluding the jaws and stings of their hosts, they scrounge whatever bits of food they can.

The marching colony, I later learned, was of a kind often referred to as one of the "miniature army ants" belonging to the genus *Neivamyrmex*. Decatur was close to the northern limit of army ants of any kind.

I met the species again as a freshman at the University of Alabama, when in the woods at nearby Hurricane Creek I discovered army bivouacs in rotting pine logs. I could scoop up entire colonies in this passive part of their life cycle and transport them to the laboratory for close study. I was strictly forbidden from letting them march through the halls of Josiah Nott Hall, the headquarters of the department of biology, but I could study them in their quiescent state. In so doing, I made a remarkable discovery. I found none of the silverfish seen in the Decatur procession, but instead an abundance of tiny beetles, among the smallest of any kind on Earth. They were, I learned later, members of the genus *Paralimulodes*, the first ever found outside South America. On stiff, short legs they skittered over the bodies of the ants and hopped from one to the next. They behaved like fleas. And what did they eat? Not what you'd expect. They licked up oily liquid from the body surfaces of their relatively gigantic hosts. The ants seemed not to mind their ministrations. They made no effort to catch or chase them away.



A worker of the army ant *Neivamyrmex*, found in the United States as far north as the Tennessee River. *(Drawing by Kristen Orr.)*

Years later, during a field trip to Louisiana, as I slept on an air mattress laid on the forest floor, I encountered army ants in a wholly different way. Sometime in the middle of the night I awoke to find ants swarming over my mattress and onto my body. They were the same *Neivamyrmex*, or a close species, likely on a march to a new bivouac. For them my body was just another obstacle to maneuver, like a backyard fence at home in Alabama.

The legionary behavior of army ants is understandably bizarre to humans, but during the grand million-year drama of ant evolution, it has been an outstanding success. Every continent save Europe and Antarctica has its own genus (group of related species) or multiple genera of legionary ants. *Neivamyrmex* is the example in North America and on south into the tropics. The ferocious *Eciton* are the inspiration of the famous 1938 short story by Carl Stephenson, "Leiningen versus the Ants," and the subject in turn of the 1954 film *The Naked Jungle*, featuring Charlton Heston with Eleanor Parker bravely at his side defending his cocoa plantation

from a mile-wide mass of biting, stinging ecitonines. And far from least among army ants are the *Anomma* and *Dorylus* driver ants of Africa, which in real life rival or exceed even the fiercest ecitonines.

The ecitonines, confined in most cases to tangled understory vegetation, move frequently from site to site, ready to attack and fight to the death any intruder of their bivouacs or foraging legions. Many among them form a soldier caste armed with long, scimitar-shaped mandibles, making the colonies even more difficult to study. However, just that was accomplished with high distinction by a psychologist turned entomologist, Theodore C. Schneirla, who conducted research on ecitonine army ants primarily in the field from 1933 through 1965. His conclusions were confirmed and extended during the 1960s by his equally brilliant acolyte Carl W. Rettenmeyer. Their work, with that of others, was summarized in my own synthesis, *The Insect Societies*, published in 1971.

As a young scientist, I knew Ted Schneirla personally and followed his research closely. I found him a calm, intense man, deeply serious about his work. He was guided by two overarching goals linked in purpose. The first was to thoroughly understand these intricately organized social insects, firmly driven by instinct. Next, being a psychologist, he wanted to show that their repertoires of behavior are guided by individual learning. If well-defined instinct in a small-brained insect is a product of learning, Schneirla reasoned, then so are all other forms of behavior. A heavy stress on experience and learning was politically very popular during the time from the 1920s to the 1960s, because it contradicted eugenics and offered hope to those proposing individualistic democracy. I don't think, however, that the amazing account of army ant biology by Schneirla and Rettenmeyer was affected by ideology. They described army ants

as they saw them.

Some of the best work of the two entomologists was on a particular species, *Eciton burchelli*. It has a mode of hunting unusual among army ants in general, called swarm raiding. As the workers leave the tightly packed swarm, they spread out in a fan-shaped mob that grows into a broad advancing front. Later they pull back, shrink their fan, and return to the bivouac. The *Eciton burchelli* swarm is an overwhelmingly powerful force. A majority of the workers pour out of the bivouac in a living mass of between 150,000 and 700,000 individuals. The fan they form spreads forward at a speed of up to 20 meters an hour. When they encounter a stream or a deep crevice, the forward workers link legs and jaws to form living bridges.

The swarm raiders on the march are horrific in their activities, on a smaller scale worthy of the aforementioned "Leiningen versus the Ants." "The huge sorties of *burchelli*," Schneirla wrote, "bring disaster to practically all animal life that lies in their path and fails to escape." He continued:

> Their normal bag includes tarantulas, scorpions, beetles, roaches, grasshoppers and the adults and broods of other ants and many forest insects; few evade the dragnet. I have seen snakes, lizards, and nestling birds killed on various occasions; undoubtedly a larger vertebrate which, because of injury or for some other reason, could not run off, would be killed by stinging or asphyxiation.

The *burchelli* swarm raids can be viewed as an ecological scythe that cuts back and forth across the rain forest floor. On Panama's Barro Colorado Island, which has an area of about 16 square kilometers, entomologists have found about fifty colonies active at any one time, each for half the day traveling up to 200 meters. They can be heard at a distance, first the rustling and hissing of

their footfalls and those of their fleeing prey, then the buzz from clouds of parasitic flies above them. Finally are heard calls of up to ten species of antbirds that take a share of the fleeing prey. The number and diversity of insects, spiders, and other invertebrate animals drops precipitously in the path of a swarm, but still perturbs too small a fraction of Barro Colorado to have an island-wide effect. Think of the army ant colonies not as vacuum cleaners but as the equivalent of fifty large carnivores, for example jaguars or pumas, feeding not on deer and peccaries but on prey finely divided into creatures of small size and immense variety.

A hallmark of ecosystems is the presence of primary food producers. In this category are the ants themselves, plus a wide variety of other organisms dependent upon them. In my first experience with army ants, the miniature species of *Neivamyrmex* I found in Alabama, I discovered a paltry crew of such hangers-on, a silverfish and some unidentified beetles. In the army ant colonies of the American tropics, on the other hand, Carl Rettenmeyer and later researchers discovered hundreds of species of such guests, including oonopid spiders; circocyllibanid, coxequesomid, laelaptid, planodiscid, scutacarid, macrochelid, neoparasitid, and pyemotid mites; nicoletiid silverfish; carabid, limulodid, staphylinid, and histerid beetles; phorid, conopid, and tachinid flies; and diapriid wasps.

Rettenmeyer's list is certain to prove incomplete. Yet even the great variety of these parasites and predators known to date is not nearly as impressive as the techniques they have evolved over millions of years to achieve intimate life with their army ant hosts. The limulodid beetles and nicoletiid silverfish clamber over the bodies of the ants, feeding on their body secretions and stealing food the ants bring into their bivouacs. The circocyllibanid mites ride on the inner curved surfaces of the soldier's long mandibles. Other mites, in the genus *Antennequesoma*, which are shaped like

clothespins, stay permanently clasped to the base of the workers' antennae. Adults of the histerid beetle *Euxenister* ride ant workers like jockeys on horseback, with their long legs clasped around the mid-bodies of their hosts. Perhaps the most astonishing of all is a *Macrocheles* mite that attaches itself to the tip of the hind foot of the worker, from which it siphons blood but also serves as an extra "foot," thus managing not to interrupt the running of its host.

The strange world of the army ants and their symbiotic guests remind us of an important principle of parasite biology—practiced by creatures ranging from disease-causing bacteria to human criminals—that the most successful parasite is the one that causes the least damage.

5

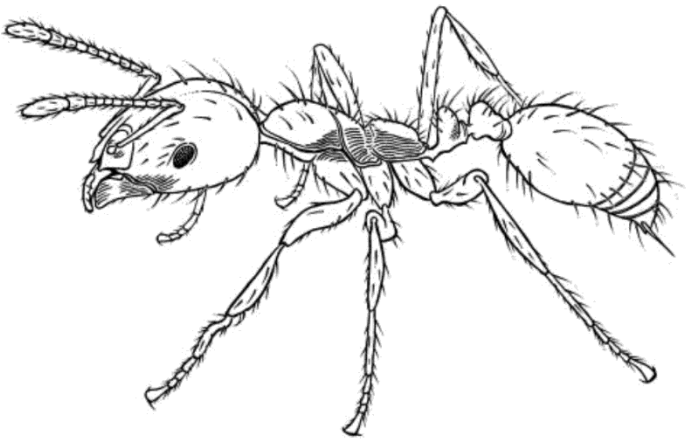
FIRE ANTS

ONE DAY, AS I sat on a field chair in the center of Dauphin Island, the main Gulf of Mexico barrier island of Alabama, I was seized by a reckless impulse. A mound nest of imported fire ants was at my feet, and I was talking about them on camera for a television special, *Lord of the Ants*. I wondered, as I had many times before, why exactly are these insects called "fire" ants? I had been stung, as have a majority of people who spend much time outdoors within reach of this notorious pest. Usually, however, the attackers are brushed off quickly and the pain is local and temporary.

But I knew these ants can kill you. So, Rule Number One: never sit, stand or fall into a fire ant mound. If you've acquired an allergy to the venom, you might suffer the consequences of anaphylactic shock. If you are with a small child who stumbles into a mound, triggering a massive attack, the result also can be life-threatening.

So I had this impulse: with the camera running, a record potentially permanent, why not experience a massive attack—then, of course, end it quickly. I would be able to report definitively why *Solenopsis invicta* is called a fire ant. Without thinking about it too long, I thrust my left hand (left because I'm

right-handed) all the way to my wrist into the center of the mound and held it in place for about five seconds, then pulled it out and brushed off the large number of ants already stinging it.



A worker of the imported fire ant *Solenopsis invicta*, a native of temperate South American wetlands, which was accidentally introduced into the port of Mobile, Alabama, and spread as a major pest around other parts of the world. *(Drawing by Kristen Orr.)*

Even in that short time, my hand became densely sprinkled with ants doubled up and stinging my skin. A smaller number were running up my forearm in a frenzy to get to other parts of my body. The colony had not been forewarned, yet its ferocious response was almost instantaneous. In a life-or-death drama for them, fire ants were quicker than the enemy.

The pain was immediate and unbearable. As I described it on the spot to my companions, it was as though I had poured kerosene on my hand and lit it. Within seconds fifty-four defending ants had stung my hand and wrist. I can be sure of that number, because each fire ant sting develops a pustule, and if one scratches the burning sting, it may become infected. The ants seem

to say, you have been left with a little reminder: don't mess with our home.

An imported fire ant queen surrounded by her worker daughters, who may come to number in the hundreds of thousands. The workers are attracted by her powerful pheromones. *(Photograph by Walter R. Tschinkel.)*

Another notable event occurred the same day. I had brought the film crew to Dauphin Island on the promise that the island—famous as a destination of birds migrating north from Yucatán across the Caribbean—is also notable for the density of fire ant mounds. I believed that there would be many places providing a suitable background against which we could observe and talk about the habits and social behavior of this formidable insect.

But with cameras ready to roll, at first we found nothing to film. The crew and I searched unsuccessfully from one end of the island to the other, in natural habitats and in residents' yards and commercial buildings. Finally, two nests were located within the bird sanctuary, one of which was used in my demonstration of the

fire ant stinging defense. How could an entire population vanish overnight? It was as though a giant hand had swept all the colonies away. And that is almost exactly what happened.

I knew the reason. As water rises around a nest of fire ants, or enters the lowermost chambers of the nest, the whole colony unites. The workers come together in a single mass near the entrance. The queen walks or is nudged and pulled into the mass. The helpless young, eggs, larvae, and pupae are carried in and placed there with her. As the water rises to ground level, the clustered colony becomes a raft, ready to float downstream. The living raft thus begins a journey to higher land, in search of a place where the workers can build a fresh domed nest.

The procedure is based on primeval instinct. When the raft touches and stops at any stationary object above the floodwater level, whether a tree branch, a snagged log, or (most hopefully for survival) a rise of dry land, scouts run onto it to investigate. If the landfall is promising, more scouts are recruited. When signs stay positive, the number of workers going ashore rises, they move the queen and young over, and the refugees build a completely new nest around the whole.

I once traveled to Birmingham on a train that crossed the Coosa River in flood. Because water had reached the edge of the railbed, the train moved slowly and at one point stopped, allowing me to peer out a long time in all directions. The broad floodwater plain was peppered everywhere with hundreds of fire ant rafts, all floating slowly toward and around the train, then on away downstream. They were an immense army of refugees in search of a new home.

To complete the story, what happened to most of the Dauphin Island fire ants? Where did all those colonies go? The day before the film crew and I arrived, ten inches of rain had fallen on the island. Torrential rainfall of this magnitude is not unusual for this

part of America. Mobile, Alabama, and nearby Panama City, Florida, compete with Highlands, North Carolina, for being soaked with the highest rainfall of any municipal area in North America. The sun was shining when we arrived on Dauphin Island, but an inch or two of rainwater still covered much of the land. The surplus had begun to seep back into the ground. Early on, at the height of the storm, a large part of it had drained northward, into Mobile Bay, whose brackish waters empty farther east into the Gulf of Mexico. And that is what I believe happened to the Dauphin Island fire ants, emigrating on their rafts made by joining their own bodies. To use a famous line from the great gangster movie *The Godfather*, I believe they sleep with the fishes.

6

HOW FIRE ANTS MADE ENVIRONMENTAL HISTORY

DURING THE SUMMER of 1942, four species of ants lived in the vacant lot next to our century-old family house on Charleston Street in Mobile, Alabama. Exactly four. I know that number with certainty because I examined every cubic foot of the grubby abandoned space, ground, weeds, and rubbish. Working with a sweep net and crawling on my hands and knees I learned every bit of it—as well as the bedroom in which I slept and the kitchen in which I ate my meals. To this day I remember vividly the location of every ant colony that lived in the vacant lot. I also learned a bit about their colony size and behavior. Today I can give you their scientific names.

In 1942 I was an ambitious thirteen-year-old Boy Scout preparing myself, as I imagined it, to someday lead grown-up expeditions to faraway jungles. I devised in the vacant lot what today is called an ATBI, for All Taxa Biodiversity Inventory. The simple but often difficult procedure is to identify all the species of a selected group of organisms in a designated space and time.

Ed Wilson at 13, in summer 1942, with sweep net in the vacant lot adjacent to the old Wilson house in Mobile, Alabama, next to a nest of imported fire ants, the first recorded in the United States.

This summer in hot, humid Mobile, the fauna of my designated group were the ants. Those I found in the vacant lot proved providential, far beyond what I could possibly imagine at the time.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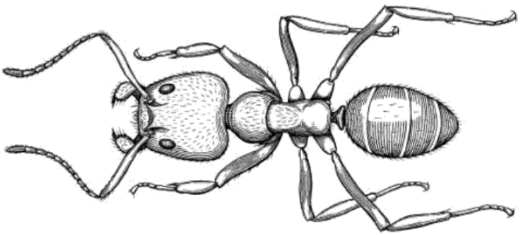
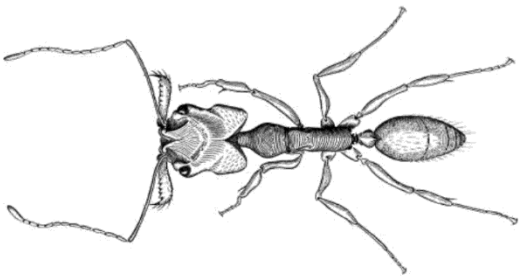
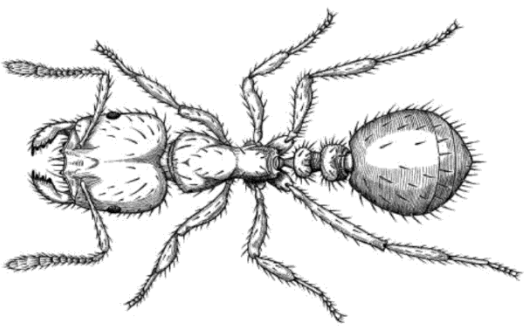
Linepithema humile



Odontomachus brunneus



Solenopsis invicta



Four species of ants lived in the weed-grown vacant lot next to the author's Mobile, Alabama, home in 1942. One, not shown, was *Pheidole floridana*, a colony of which lived beneath a discarded whisky bottle. *(Drawings by Kristen Orr.)*

Our house, built by my great-grandfather, an early furniture merchant, was an excellent place to look for newly invasive species. It was within five city blocks of Mobile's commercial docks. Much of the cargo came from Argentina and Uruguay, part of the homeland of the imported fire ant. My father, as a teenage seaman, had made the round trip from Mobile to Montevideo.

My vacant-lot fire ant colony nevertheless could not have been the very first on shore. Had I searched away from the Charleston Street vacant lot during the summer of 1942, I almost certainly would have discovered other colonies in the dock area, and possibly in other parts of Mobile. It seems likely, most experts now agree, that the introduction of the imported fire ant occurred sometime in the 1930s. But not earlier: established colonies grow in size swiftly. They begin to produce and disperse new queens, hence new colonies, within one or two years.

During the remainder of the 1940s entomologists, now aware of the species, watched its populations grow explosively. It filled Mobile and then all the land beyond the city.

Soon what had begun in Mobile became a national problem, then international. The imported fire ant spread to the Carolinas, next to Texas and California. It put ashore on Hawaii and made beachhead in Australia, New Zealand, and China. It also spread south onto several islands of the Lesser Antilles—as though headed back home, island by island. In Alabama it filled lawns, roadsides, and farmlands, reaching up to fifty mound nests per acre, each teeming with as many as two hundred thousand workers, almost all seeming poised to attack intruders. On farms in the surrounding counties, the ants consumed seedlings of radish, alfalfa, and other money crops. They rendered pastures used for cattle difficult to attend. They managed to forage into rural homes, stinging freely.

It soon was discovered that in a few natural habitats, among

them especially open pineland, the imported fire ants were attacking small mammals and ground-nesting birds.

Later, as a nineteen-year-old senior at the University of Alabama, having become locally famous as an expert on ants, I was asked by the Alabama Department of Conservation to study the rapidly expanding populations, map their spread, and assay the harm they were causing.

Because the foot-high mounds are so conspicuous and because the impact on people was so striking and widespread, and because I was assisted by James H. Eads, a fellow student who providentially owned a car, the survey proceeded rapidly.

At the price of countless stings and pustules, we confirmed the nature of the damage caused by the invaders. We also picked up considerable new information about the fire ant life cycle. Of importance was the discovery that a single newly inseminated queen can fly up to five miles, build a little nest, and rear worker offspring fast enough to create new queens within two years.

In short, we discovered that the imported fire ant would be very difficult to defeat by conventional means—and in particular by the use of insecticides. This reservation, however, did not stop the U.S. Department of Agriculture and the chemical industry planning precisely that: spray the entire range of the imported fire ant with pesticides in order to wipe it out in one strike.

At first, the ambition seemed justified. The 1950s were a period of American triumphalism. We had saved the world from the armies of fascism. We had slowed if not halted global communism. Our science and our technology were achieving wonders. Americans were ready to think big, really big. We could do anything. Having graduated from atomic to hydrogen bomb weaponry, it was natural to think of the peaceful uses possible in nuclear detonations. In 1957 the Atomic Energy Commission prepared to take a literal, not merely rhetorical, giant step: use

nuclear explosions as giant shovels. We could free hitherto inaccessible natural gas deposits. We could, if we wished, scoop out a new harbor in Alaska. And best of all, we could dig a new channel parallel to the overcrowded Panama Canal, achieved with a string of nuclear blasts that would join the waters of the Pacific and the Caribbean. All this portended profound effects on the environment —none good.

Each of the megaproposals soon met with predictions of geological disaster, and they died away. But their spirit did not, and it soared on up with America's triumphs in space, medicine, and basic science. The same spirit also made it seem natural that a major invasive insect such as the imported fire ant could be halted, if not eradicated, by an American force majeure.

In 1958, the U.S. Department of Agriculture planned to engineer the spraying of most of the infested area of the southern United States with the pesticides heptachlor and dieldrin. The fire ant populations would be greatly reduced, but far from completely erased. At the same time, the quantity of wildlife, including mammals and birds and with certainty other insects and invertebrates as well, would also be diminished. Finally, people in the treated area were also put at risk: heptachlor can cause liver damage and dieldrin is a neurotoxin.

The entire effort at mass control was critically flawed because of another, insoluble difficulty: if, despite soaking the terrain with pesticides, a single fire ant colony was left alive, it would proceed to do what every colony does with genius: produce hundreds of winged queens, each able to fly out five miles or more and establish a new colony. This singular biological feat was the reason that I later called the mass spraying "The Vietnam of entomology."

At about this time Rachel Carson entered the fire ant scene. She was appalled at what America was doing to itself. Because I was at that time known as an expert on fire ants, Carson wrote to

me with the suggestion that she come down from her summer home in Maine to Harvard for a discussion on the overall problem. Then she canceled, reporting that she had become ill. I followed up by recommending a recently published technical work on the effects of wide pesticide application. I believe that helped, but I have always regretted not dropping everything and driving up to Maine to meet this great American personally.

Rachel Carson, however, didn't need further help. In 1963 she published *Silent Spring*, which revolutionized our thinking about pesticides, and, more than any other single event or contribution, launched the new era of environmentalism. It is worth noting that one ant species, first seen (to the best of my knowledge) on the edge of a vacant lot in a Southern port city, played a significant role in its appearance.

The story of the imported fire ant leads me to turn back five hundred years, when another fire ant, *Solenopsis geminata*, changed history during the colonization of the New World. Or so I concluded, after a good deal of research that combined history and entomology. This analysis suggests a rule of environmental history: all human-caused disasters repeat themselves. The story follows.

7

ANTS DEFEAT THE CONQUISTADORS

FOR HALF A millennium, an entomological mystery had shrouded the early history of the New World. During or soon after 1518–19, a plague of stinging ants struck the fledgling Spanish settlements on the island of Hispaniola. According to the eyewitness account by the colonial historian Bartolomé de Las Casas, the ants destroyed or made inaccessible a substantial part of the early crops, and they infested the first dwellings.*

The colonists found themselves powerless against the rapidly expanding swarms, which also spread to their Cuban and Jamaican settlements. In desperation, they designated a patron saint in their plea for divine help. They conducted a religious progression through the little village of Santo Domingo. Finally, they moved the settlement across the Santo Domingo River.

It was all to no avail. The colonists talked of leaving the island altogether.

Fortunately for modern science, some of the key traits of the Hispaniola plague were reported by Las Casas. The ants, he said, were very aggressive, and able to deliver painful stings. They

Frontispiece: An African warrior ant, or matabele (*Megaponera analis*), specialized for raids on mound-building termites. Its common name is that of the Zimbabwe warriors Long Shield. *(Original painting by Timo Wuerz.)*

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