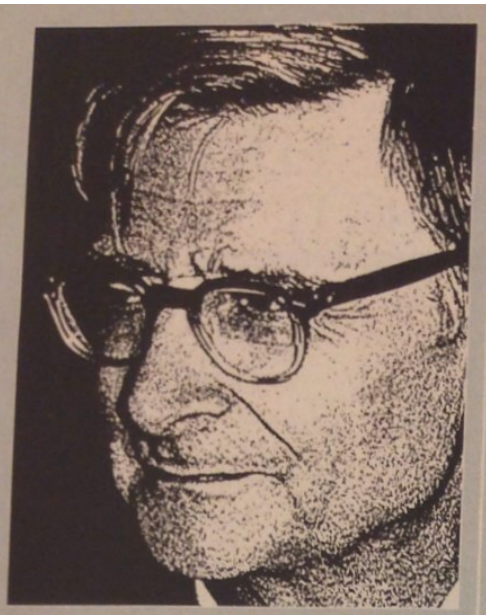

FIRST WORD

By Edward O. Wilson

"If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed 10,000 years ago. If insects were to vanish, the environment would collapse into chaos."

The question I am asked most frequently as an entomologist is whether insects will take over the world if the human race extinguishes itself. Insects already dominate the earth. They were among the first animals to evolve on the land nearly 400 million years ago. By Carboniferous times, 100 million years later, insects had developed into forms nearly as diverse as those existing today; and they have dominated terrestrial and freshwater habitats around the world ever since (for some reason not yet fully explained, insects never penetrated the sea). The human race is a newcomer, less than 1 million years old, and our grip on the planet is tenuous.

Living insects number about 1 billion billion. This amounts to a trillion kilograms of living matter, roughly the same as humanity. The total number of known species—in other words, those given a formal name (such as *Musca domestica* for the housefly)—is slightly in excess of 750,000. The true number is far greater, however. As many as 30 million species are alive today, mostly in tropical forests.

Insects comprise more species than all other organisms combined—including plants, animals, and microorganisms. And the small band of entomologists who specialize in classifying insects are deluged continuously with forms previously unknown to science. As one of those entomologists, I am currently studying a group of ants with more than 300 species lacking names. Every time I make a field trip I turn up still more new species, often within hours.

The immense protoplasmic bulk and diversity of insects place them among the little things that run the earth, up there with bacteria, algae, and copepods (minute sea crustaceans). Consequently, humans depend on the vast variety of insects for survival; but they have little use for us. If all mankind were to disappear tomorrow, it is unlikely that a single insect would go extinct except for three kinds of body lice—and even then there would still be gorilla lice, closely related to the human parasites. In two or three centuries, the ecosystems of the world would regenerate back to the rich state of equilibrium that existed 10,000 years ago.

But if insects were to vanish, the terrestrial environment would collapse into chaos. Most of the flowering plants, lacking pollinators, would soon perish. The great majority of mammals, birds, and other land vertebrates, losing the specialized foliage, fruits, and insect prey on which they feed, would follow the plants into oblivion. The soil would remain unturned because insects—not earthworms—are the principal burrowers and renewers of the earth. Wind-pollinated grasses would spread across a deforested, impoverished world. Humanity would suffer immensely, horribly, pushed to the edge of extinction.

Insects run the terrestrial world with such efficiency that most people take no notice of our close dependency upon them. Humans think of most insects as ugly, even repellent. This "yucky" factor is an adaptive response: Instinctively we stay clear of venomous and disease-carrying species. Fortunately, ecosystems are not endangered by our squashing an occasional wasp or spider.

Most urban dwellers, however, are largely unaware of the minute fraction of insect species classified as our enemies, and the terrible damage such species can cause. Few know that malaria, carried by *Anopheles* mosquitoes, is on the rise again throughout the tropics. In Africa alone it kills 1 million children under the age of five each year. Elephantiasis, a crippling condition spread by mosquitoes and biting flies, now afflicts 400 million people around the tropics.

Agricultural pests also continue to prosper and multiply, causing billions of dollars in damage around the world each year. Many of the insects have developed genetic resistance to pesticides, so that the damage to crops in the United States has actually risen from 7 percent in the Forties to 13 percent at the present time. There have been some dramatic successes in the control of individual pest species but just as many expensive failures. Humans have worsened the outbreaks by the careless management of agricultural environments, causing the loss of natural parasites and predators that keep the pest species in check.

For millions of years, life on the land was locked into place and kept humming along by a partnership between insects, the most diverse of the animals, and flowering plants, the most diverse members of the plant kingdom. Humanity then joined the partnership, with looming disaster for itself and the remainder of life. There are too many of us, and we still know too little about the living world to coexist with other species harmoniously. We are destroying the habitats in which most kinds of organisms live, threatening thousands of plant and millions of insect species—more than perished at the end of the Age of Dinosaurs. We have not learned how to protect ourselves from the tiny minority of insects that harm us, at the same time preserving and making better use of the vast majority that sustain us. Indeed, the future task of entomology in the years ahead is one of the most important and complex challenges in all of science.

Edward O. Wilson, Baird Professor of Science at Harvard University, is the recipient of both the National Medal of Science and the [illegible]

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FIRST WORD

By Edward O. Wilson

The question I am asked most frequently as an entomologist is whether insects will take over the world if the human race extinguishes itself. This is an example of a wrong question directed to a misleading answer. Insects have already taken over. They were among the first animals to evolve on the land nearly 400 million years ago. By Carboniferous times, 100 million years later, they had radiated into forms nearly as diverse as those existing today. They have dominated terrestrial and fresh-water habitats around the world ever since (for some reason not yet fully explained, they never penetrated the sea). The human race is a newcomer, less than a million years old, and our grip on the planet is tenuous.

Living insects number about a billion billion. At nearest order of magnitude this amounts to a trillion kilograms of living matter, roughly the same as humanity. The total number of known species, in other words those given a formal name (such as *Musca domestica* for the house fly), is slightly in excess of 750,000. The true number is far greater, however. As many as 30 million species are alive today, mostly in tropical forests. Insects comprise a majority of the species of all organisms combined--of plants, animals, and microorganisms. The small band of entomologists specializing on classification are continuously deluged with

forms previously unknown to science. As one of them, I am currently studying a group of ants with more than 300 species lacking names. Every time I make a field trip I turn up still more new species, often within hours. In this sense, scientists have not begun to take the measure of the dominance of insects.

The immense protoplasmic bulk and diversity of insects place them among the little things that run the earth, up there with bacteria, algae, and copepods. We need them; they don't need us. If all mankind were to disappear tomorrow, it is unlikely that a single insect would go extinct except for three kinds of body lice--and even then there would still be gorilla lice, closely related to the human parasites and bearing most of the same genes. In two or three centuries the ecosystems of the world would regenerate back to approximately the rich equilibrial state that existed ten thousand years ago. But if insects were to vanish, the terrestrial environment would collapse into chaos. Most of the flowering plants, lacking pollinators, would soon perish. The great majority of mammals, birds, and other land vertebrates, lacking the foliage, fruits, and insect prey on which they are specialized to feed, would follow the plants into oblivion. The soil would be largely unturned because insects--not earthworms--are the principal burrowers and renewers of the earth. Dead vegetable matter would pile up, especially in warmer climates, because of the lack of termites and wood-boring beetles. Wind-pollinated grasses

would spread across a deforested and impoverished world. Humanity would suffer terribly, pushed to the edge of extinction.

Insects run the terrestrial environment with such efficiency that most people take no notice of our close dependency upon them. They think of most insects as ugly, even repellent. This "yukky" factor is an adaptive response: it makes sense to stay clear of venomous and disease-carrying species by instinct, and ecosystems are not endangered by squashing an occasional wasp or spider. In fact most urban dwellers are largely unaware of even the minute fraction of insect species classifiable as enemies, and the terrible damage such pest species cause. Few know that malaria, carried by *Anopheles* mosquitoes, is on the rise again throughout the tropics. In Africa alone it kills a million children under the age of five each year. Forty million people in Africa have been blinded by onchocerciasis, transmitted by black flies closely similar to the ones that infest the north woods. Elephantiasis, a crippling condition spread by mosquitoes and biting flies, now afflicts 400 million people around the tropics and may be the world's fastest spreading disease.

Agricultural pests also continue rampant, causing billions of dollars damage yearly around the world. Many of the insects have developed genetic resistance to pesticides, so that the damage to crops in the United States has actually risen, from 7 percent in the 1940s to 13 percent at the

present time. There have been some dramatic successes in the control of individual pest species, but just as many expensive failures. In many cases human beings have worsened the outbreaks by the careless management of agricultural environments, causing the loss of natural parasites and predators of the pest species.

For millions of years life on the land was locked into place and kept humming along by a partnership between insects, the most diverse of the animals, and flowering plants, the most diverse members of the plant kingdom. Humanity then joined the partnership in a big way, with looming disaster for itself and the remainder of life. There are too many of us, and we still know too little about the living world to get along harmoniously. We are destroying the habitats in which most kinds of organisms live, threatening thousands of plant and millions of insect species, more than perished at the end of the Age of Dinosaurs. We have not learned how to protect ourselves from the tiny minority of insects that harm us, while preserving and making better use of the vast majority that sustain us. The task of entomology in the years ahead is one of the most important and complex challenges in all of science.

Edward O. Wilson, Baird Professor of Science at Harvard University, is the recipient of both the National Medal of Science (1977) and Pulitzer Prize in General Non-fiction (1979).