Leafcutters

Gardeners of the Ant World

With powerful saw-toothed mandibles, a leafcutter ant slices through a papaya leaf—first step of an elaborate process in which her colony uses mulched vegetation to raise the fungus on which it feeds. Seen at 50 times life-size, the tiny creature belongs to a remarkable group of ants that evolved a system of agriculture eons before the advent of humans.

Text and photographs by
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Living buzz saws

Chief herbivores of the New World tropics, where they originated millions of years ago, leafcutter ants strip away more vegetation than any other animal group. In rain forests their actions remove about 15 percent of leaf production. Members of the attine tribe of ants—the fungus growers—leafcutters enjoy a nutritional relationship with their fungus that enables them to thrive on fresh leaves—matter usually indigestible by ants.

Some leafcutters compete with human farmers. *Acromyrmex octospinosus,* introduced onto Guadeloupe by accident in the early 1950s, is now a major pest to squash and cassava planters. By rapidly oscillating her hind end, this ant (above) cuts out a crescent of leaf with vibrating mandibles in much the same manner as an electric carving knife. The sound serves to attract other workers—all females—to the site to finish off the leaf.

On the mainland the far larger colonies of *Atta cephalotes* normally invade gaps in the rain forest caused by fallen trees or by agriculture. In French Guiana a column of leaf-toting workers return to their nest along a convenient prostrate trunk (right), following chemical markers deposited by scouting ants. More often they travel along wide pathways they have worn into the jungle floor. Wherever the plants are most attractive, traffic intensifies. Often I watched in amazement as hundreds of dime-size green banners would pass by every minute in caravans 200 yards long. The ants' speed and energy have also impressed my Harvard colleague Edward O. Wilson, who calculated that, scaled to human dimensions, each worker runs the equivalent of a four-minute mile for 30-some miles, with 500 pounds slung over her shoulders.

The voraciousness of large leafcutter ant colonies is legendary. Yet workers rarely kill whole trees, because they constantly shift their activities to new plants. Since the ants use the vegetation to raise fungus, this strategy may assure that their gardens do not overdose on the chemical defenses of any one plant species. Imported human crops are choice targets for the ants, because their leaves usually lack natural fungicides.

Kingdom of leafcutter ants

Leafcutters are most abundant in tropical countries like Brazil, known to Portuguese settlers as the Kingdom of the Ants.

Worlds underground

Huge subterranean ant colonies dot the landscape of central Paraguay with mounds of silt excavated by billions of hours of ant labor. Considered a pest on the savanna, grass-eating leafcutters reduce the number of livestock the land can sustain. Occasionally cattle are injured when a mound collapses underfoot. What lies beneath is seen close-up in Brazil, where biologist Virgilio de Silva, at left, examines a partly excavated nest, riddled with exposed fungus gardens. The depth of such nests—which support active colonies for a decade or more—appears to be limited only by the level of the water table beneath.

Native palms sprout from the mounds of dying colonies, at bottom right, illustrating the positive effect of the ants on their environment. Leafcutters turn over and aerate large quantities of soil in forests and grasslands. Imported by humans, cattle are actually the intruders here.

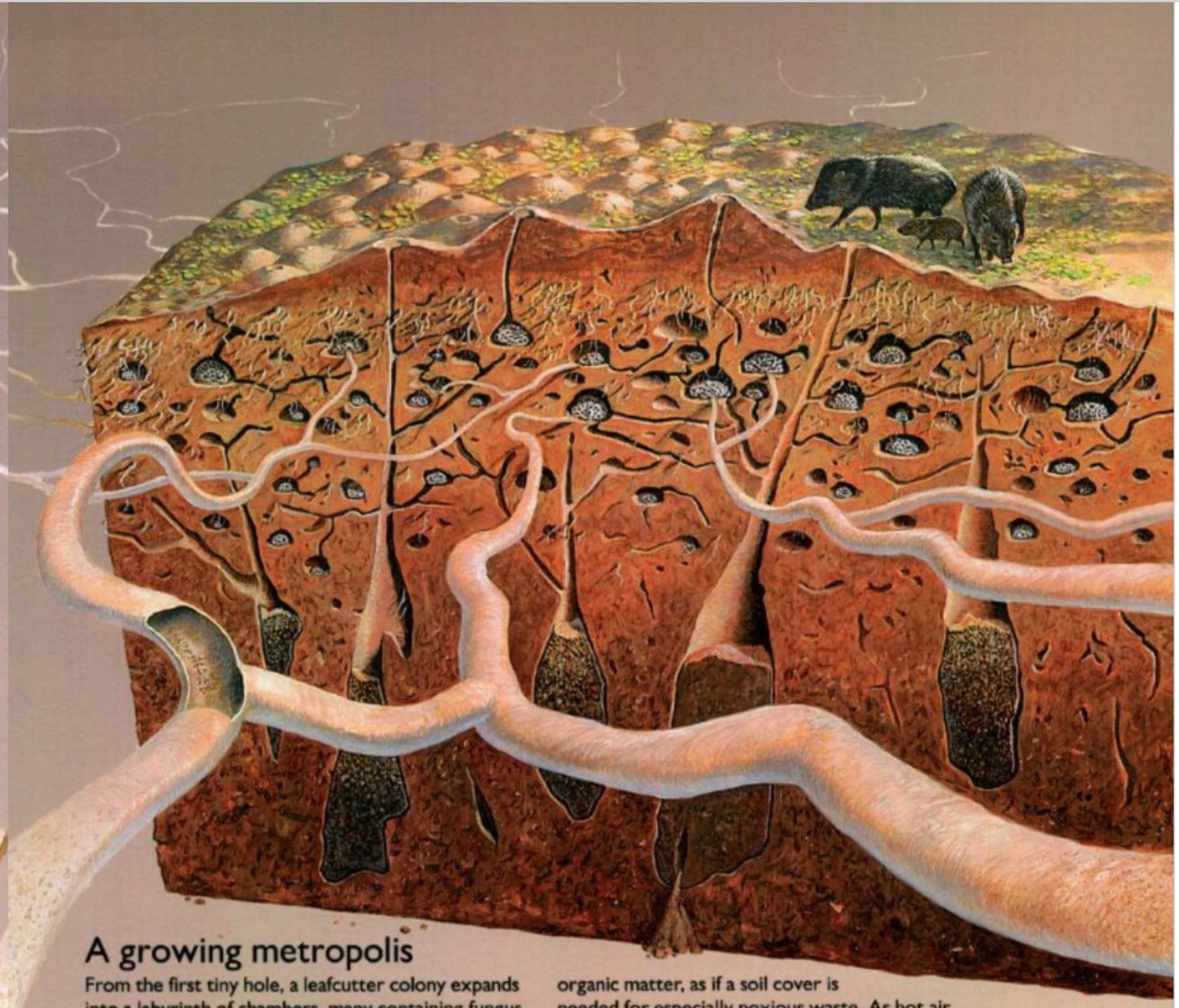
The ant proletariat

A society of females, like all ants, leafcutters are daughters of the same queen. Kept infertile by chemicals from their mother, young females become workers. The size, appearance, and function of newly emerged adults—their caste—is determined by the amount of fungus they were fed as larvae. A soldier—shown below left, above a queen—may be hundreds of times the weight of members of the smallest caste. Hatched from the queen's unfertilized eggs, males contribute nothing except their sperm and are programmed for a speedy death after their nuptial flight.

Assembly line

Only the largest nonsoldier workers leave the nest to forage (1). Inside the nest, slightly smaller workers chop leaves into bits (2), which the next caste chews into pulp and fertilizes with deposits of enzyme-rich fecal fluid (3). Other ants apply the fertile leaf paste over a base of dried leaves in new chambers (4). Another caste hauls in bits of fungus from older chambers and plants it in the leaf paste (5), over which it will spread like frost. A teeming caste of dwarfs (6) cleans and weeds the garden, then harvests the fungus for others to eat.

PAINTING BY JOHN D. DAWSON



A growing metropolis

From the first tiny hole, a leafcutter colony expands into a labyrinth of chambers, many containing fungus gardens resembling a human brain. The gardens nearly fill the chambers, which are located near the surface for this species, *Atta sexdens*. Larger, deeper pits hold decomposing plant detritus and waste. A few of these pits, oddly, contain more soil than organic matter, as if a soil cover is needed for especially noxious waste. As hot air rises from these refuse chambers, cool, oxygen-rich air is drawn into the nest. Openings directly above the nest are used only for excavation and ventilation. Cavernous perimeter tunnels form a beltway some 25 feet from the nest.

A young queen

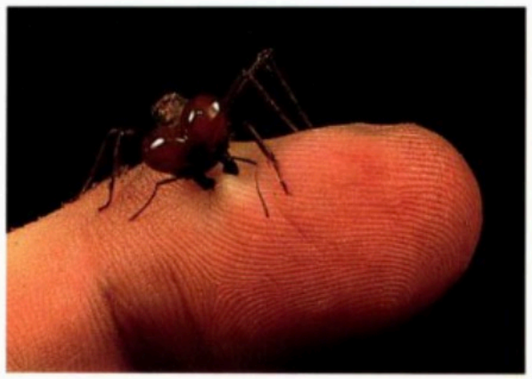
An *Acromyrmex octospinosus* queen enlarges a new nest, holding fungus grown from a tiny wad she carried in her cheek from her mother nest. Inseminated with enough sperm to fertilize millions of eggs, she has shed her wings and burrowed underground.

Farms without sun

An ancient symbiosis exists between ant and fungus, in which each is dependent upon the other for its very survival. Among the 200 or so species of fungus-growing ants, most cultivate their fungus with dead organic matter, like insect corpses and plant debris. Workers of this *Trachymyrmex* colony hung their garden from the ceiling of a four-inch-wide chamber (above) and may have used caterpillar feces, much as human farmers use cow manure, for compost.

The 37 leafcutter species are the culmination of social evolution among fungus-growing ants. Only leafcutters exploit living plants for their food production, making them by far the most conspicuous gardeners. Tending their woolly crop, the tiny workers in an *Acromyrmex octospinosus* nest (right) will harvest enough fungus to feed hundreds of thousands of nest mates. Other leafcutter ants have colonies in the millions. Except for drinks of plant sap, leafcutter ants obtain a complete and balanced diet from their fungus alone.

Call to arms



More reliant upon touch and smell than sight, two sister leafcutters on a trail in Guadeloupe check each other out with rapid strokes of their highly sensitive antennae (above). Had they been members of different colonies, each would have released chemical alarms called pheromones to summon help from their nest mates. The first arrivals, driven into a frenzy by the chemical, would tear the enemy apart.

As a colony in Belize emigrated from a site that had been slashed and burned by farmers, workers carried all the ant young (opposite) to a new location. The young included pupae that could not move on their own and a freshly emerged adult, at top, that could walk but perhaps had trouble finding her way.

Certain species have jumbo workers whose primary purpose is to defend against large attackers such as humans. Normally stationed inside the nest, these soldiers go on a rampage when alarm pheromones signal a major nest disturbance. Thousands may boil out of the ground. I watched one soldier poise herself to cut a bloody arc into my skin (above) as effortlessly as a smaller forager would cut leaves. Soldiers, I sorely reasoned, must make life miserable for the armadillos and anteaters that excavate their meals.

Fly bombing in the microworld

Choosing a target on which to lay its egg, a speck-size phorid fly swoops down on a passing leafcutter ant. Sensing its approach, the worker rears up, jaws gaping in defense. A maggot hatching from the egg would feed on the ant's head, eventually decapitating the ant.

With a leaf in her jaws (inset), a worker cannot defend herself, so small ants ride shotgun to keep flies at bay—which doesn't make hefting the burden any easier. □