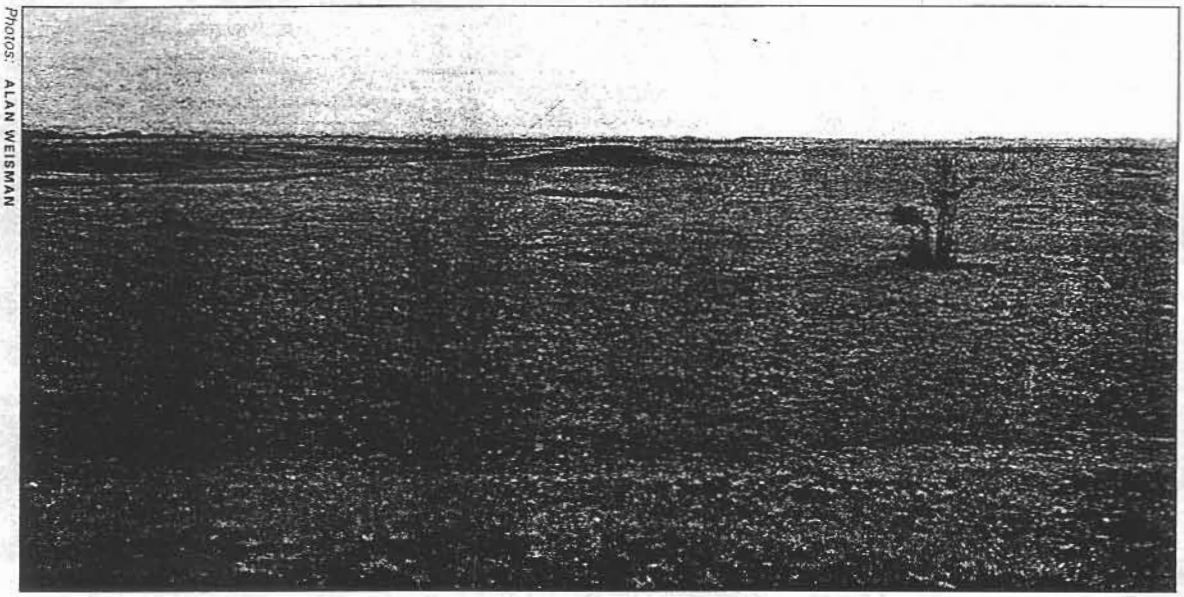
PLACE

In the "big, wet desert" of los llanos, *nothing grows except a few nutrient-poor grasses. Paolo Lugari said he could build a self-sufficient society there – and make it sustainable*

¡GAVIOTAS!

OASIS OF THE IMAGINATION

Photos: ALAN WEISMAN



by Alan Weisman

As his Land Rover crawled across Colombia's huge eastern plain, the vision gestating in Paolo Lugari's subconscious involved his hunch that someday the world would become so crowded that humans would have to learn to live in the planet's least desirable areas. *Los llanos,* he had decided, were a perfect setting to design an ideal civilization for the planet's fastest-filling region: the tropics.

Later, he would tell everyone, "They always put social experiments in the easiest, most fertile places. We wanted the hardest place. We figured if we could do it here, we could do it anywhere."

No one disagreed, but in the beginning, no one held out much hope, either. The *llanos* were good for little except inspiring *llanero* musicians to write songs about how mournful life gets on an endless prairie. Biologists believe that about 30,000 years earlier, this had been part of an unbroken rain forest clear to the Amazon. Then, climate change had created new patterns in the predominant winds. The trade winds blew inland, fanning lightning strikes into fires that burned the jungle faster than the woodlands could regenerate. A few trees and plants were able to adapt, but for the most part, the jungle receded south, where the winds diffused, leaving short-cycle, nutrient-poor savanna grasses in its stead. "It's just a big, wet desert out there," Paolo was told repeatedly.

"The only deserts," he would reply, "are deserts of the imagination."

Beginnings

Paolo Lugari passed his university exams without ever attending class. A fervid orator, he'd won competitions at Bogotá's Universidad Nacional, and, on the strength of a single inspired interview, he netted a scholarship from the United Nations Food and Agriculture Organization to study development in the Far East. Returning to Colombia in 1965, he was hired by a commission planning the future of the Chocó, a tropical wilderness that stretched the length of Colombia's Pacific coast. Today, the Chocó is one of the world's largest remaining intact virgin rain forests, inhabited by several jungle-dwelling Indian communities who have lived there for centuries.

Paolo's work had persuaded him that rain forests and excess people were a foolish mix. But after his uncle took him on an inspection flight of the Orinocan *llanos,* he started having visions. In South America alone, there were 250 million hectares of fairly empty, well-drained savannas. One day, he was convinced, they would be the only place to put bursting human populations.

From 1967 to 1970, Paolo Lugari slipped off to the *llanos* whenever his duties permitted. He went through a dozen tires, frequently got lost, waited days for ferries, collected medicinal herbs with a Guahibo Indian shaman, camped on river sandbars amid the rustling of mating turtles, stayed in a friendly *llanero's* hut when the chiggers drove him nuts, and contracted malaria twice. ("Light cases. Just a lot of chills," he assured his friends. "I bring repellent now.")

On one trip to *los llanos,* Paolo and his brother Patricio found a pair of long, concrete sheds filled with weeds. These were former warehouses of a road construction camp, now abandoned, that would have been the midpoint of the failed trans-*llano* highway.

"We're here," Paolo told his brother.

"Where?" replied Patricio, removing his driving goggles and scraping caked dust from his face. Perplexed, he looked around. What was Paolo planning to do in this desolation? Only a few sections of the warehouses' laminated roofs were still intact. Except for a small thicket of gallery forest, they were surrounded by grass in every direction.

Paolo, meanwhile, was exuberant. These buildings formed the shell casing for the idea that had bored through his mind ever since he had seen them from the air – they could be the first structures in a community expressly designed to thrive in these inhospitable, supposedly uninhabitable lands.

For now, he was home. As they leaned against the Land Rover, three small yellow-billed terns flew over. "There must be water beyond those trees," Paolo said.

"Why?"

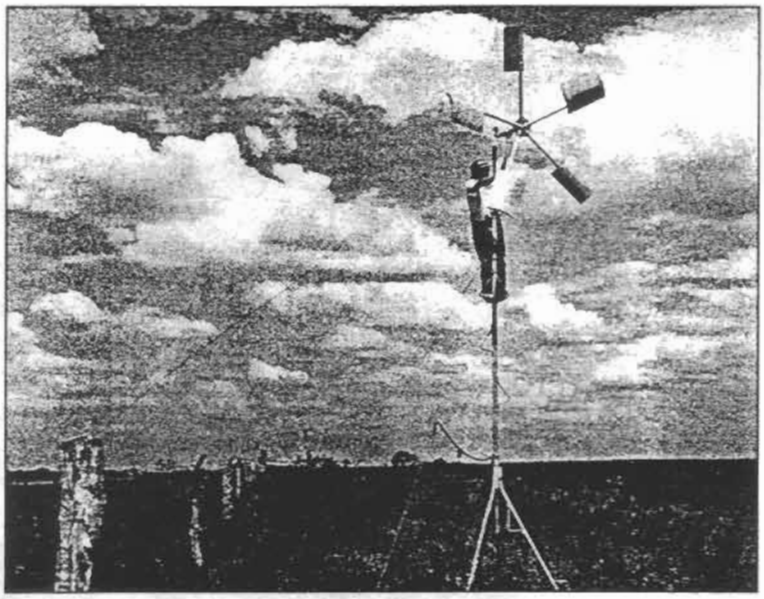
He pointed at the birds. "River gulls. They're *gaviotas.*"

A living laboratory

As Paolo's duties in the Chocó wound down, he spent more time at his camp, which he had named Gaviotas. Paolo often stayed on the nearby Río Muco with his *llanero* friend, who was growing rice, citrus, papaya, mangos, guavas, and cashew fruit. But in order for a substantial population to live here, Paolo realized, they would need to cultivate the *llano* itself, not just the thin, arable strips along its river banks.

Not long after his first trip to *los llanos,* Paolo learned that Dr. Sven Zethelius, a soil chemist at the National University, was delivering a series of lectures on the tropics. Sensing a fellow dreamer, Paolo attended the lectures whenever the Universidad Nacional wasn't closed by strikes.

One afternoon, he cornered Zethelius in his chemistry lab and explained that he'd staked a claim to the abandoned highway camp he'd found in *los llanos,* along with 10,000 surrounding hectares. "What can I plant out there?" he asked.



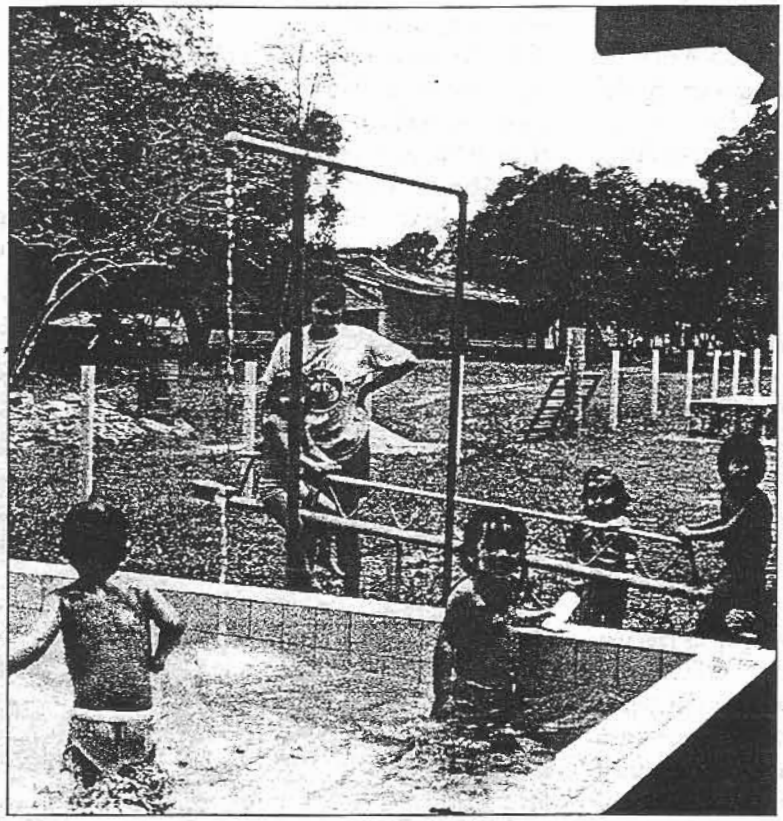
This windmill was designed to take advantage of faint, tropical breezes. Gaviotas has distributed this technology and other innovations throughout Colombia and the world

"Probably nothing." The soils around Gaviotas were only about two centimeters thick, quite acidic, and often high in aluminum toxicity, Zethelius informed him. "Frankly, they're the worst in Colombia. A desert."

"So I'm told. Look," Paolo urged, "think of them as different soils. Someday, Colombians who want land will have three choices: burn down the Amazon, do the same to El Choco, or move to the *llanos*. If we could figure out ways for people to exist in the most resource-starved region in the country, they can live anywhere."

"We?"

"Think of it. Gaviotas could be a living laboratory,



Gaviotan water pumps, like this innovative seesaw pump, brought clean, safe water to many rural South American communities

a chance to plan our own tropical civilization from the ground up, instead of depending on models and technology developed for northern climates, like the Peace Corps wants to teach everybody."

Zethelius began to nod.

"Something for the Third World, by the Third World," Paolo persisted. "You know what I mean: When we import solutions from the United States or Europe, we also import their problems."

Zethelius glanced outside. Protesters were again massing in the concrete plaza. Megaphones, then tear gas would shortly follow. "True enough," he replied. "In Colombia, we've got enough problems as it is.

At Zethelius's direction, he planted some fruit trees and also tried growing corn, without much success. He lured a pair of university soil chemistry students out to hunt for possible pockets of fertility, as well as to look for sand and clay deposits to use in construction. He hired Guahibo Indian and *llanero* workers to begin reconditioning the old highway workers' camp and building thatched living quarters. When an itinerant teacher wandered in, the scattering of families who lived in the area embraced Paolo's idea of a school, and soon the teacher had ten *llanero* kids for pupils. A nurse from Puerto Gaitan offered to come once a month. Within a year, as more people settled in Gaviotas, she was staying for a week at a time.

From utopia to topia

"You don't want to just survive out here," Zethelius's voice declared from behind his mosquito netting. They were lying in canvas hammocks under an open-air *maloca* the Guahibo had built. "You're trying to create a utopia. In *los llanos*, no less."

Paolo tried to sit upright in his hammock to look the older man directly in the eye. After flailing about briefly, he gave up. Lying back again, he said, "I want Gaviotas to be real. I'm tired of reading about all these places that sound so perfect but never get lifted off the page into reality. Just for once, I'd like to see humans go from fantasy to fact. From utopia, which in Greek literally means 'no place,' to *topia*."

But how to do that? He started by persuading the faculties of various universities around the country to send thesis candidates to Gaviotas, to dream up solutions to the challenges that concocting an ideal society from scratch in *los llanos* would entail. Word spread that Gaviotas was seeking adventurous thinkers with ideas they wanted to test. The reward: Earn a degree by helping to make the empty savannahs flourish. If the students thought they would be happy at Gaviotas, Lugari told them, Gaviotas would be their sponsor.

Which meant, they later learned, that they would get a hammock, mosquito netting, food, and a share in the cooking duties. Usually, they didn't learn this until 500 kilometers of roadless *llano* separated them from home.

Jorge Zapp, head of the mechanical engineering department at the Universidad de Los Andes in Bogotá, had needed no persuading to bring engineering students to Gaviotas. Undergrads whom he had taught how to weld and to turn a lathe were now at Gaviotas getting graduate degrees, or simply getting paid, for playing. In a drafty workshop converted from the highway crew's former heavy equipment shed, they recycled a mass of flotsam lugged from the city into prototype windmills, solar motors and water heater panels, micro-hydro turbines, biogas generators, and all manner of pumps.

Until the Arab oil embargo in 1973, Gaviotas was considered an intriguing experiment with little practical relevance. Then, as waiting in gas pump lines gave the world time to contemplate the novel notion of re-

newable energy, Gaviotas began to attract attention. Journalists appeared. After the *Wall Street Journal* published a front-page feature about a South American community that had "solved" the energy crisis by devising implements powered by energy that was actually replenishable, a delegation arrived from the United Nations Development Programme.

In 1976, shortly after the OPEC oil embargo, Gaviotas was designated as a model community to the United Nations, and this honor was accompanied by a substantial research grant. Over the years, as their successes multiplied, the UN support would grow to include travel budgets for Gaviotans to scour the world for ideas they could adapt to their tropical *topia*, and then show that same world how their approach could work anywhere. It was on one such trip in the mid-1970s that Paolo Lugari hit upon a solution to two problems at once.

Cultivating *los llanos*

He was returning from a conference in Río de Janeiro, when his plane stopped to refuel in the Brazilian jungle port of Manaus. He resigned himself to a delay that meant the airline was lodging them in Manaus's riverside palace, the Hotel Tropical. But what impressed Paolo Lugari far more that night than the neocolonial architecture were the dinner vegetables.

He collared the maître d'. "Where," he demanded, "are you getting fresh lettuce and tomatoes in the middle of the jungle?" By now he knew that the impoverished soils in *los llanos* weren't much different from those of a rain forest, and despite Sven Zethelius's diligent efforts, Gaviotas was having a dismal time producing anything nourishing from them.

"Aren't they lovely?" the maître d' agreed. "Some priests deep in the forest have a garden."

Paolo cancelled his flight, rented a boat, and went to find them. A few hours upriver, he was led to local Catholic missionaries growing greens in box planters made of palm wood, set on blocks above the slick clay jungle floor. The Brazilian priests had analyzed the soil to determine which minerals were lacking. In the boxes, they mixed dirt with decomposing jungle detritus, and compensated for the absent nutrients by adding extra cobalt, manganese, and traces of magnesium, zinc, and copper. The result was a bountiful crop of onions, chard, lettuce, and tomatoes.

Excited, Lugari went back and told Zapp and Zethelius. They had some concerns.

"Besides lacking all the minerals those priests have to add, we're missing potassium, phosphorus, calcium, and boron," Zethelius said. But the bigger problem was root disease. Introduced species, such as carrots and lettuce, had no natural defenses against the local insects, fungi, and bacteria.

"Suppose," Zapp asked Zethelius, "that instead of poisoning soil with fungicides, we just sterilized it?" Before Sven could reply, Zapp's mind raced ahead. "Got it," he announced. Instead of trying to sterilize the local soil, it would be a lot easier to make their own, and then add whatever minerals were necessary.

"Make it out of what?" Lugari asked.

"Anything. All you need is something to hold the plants in place so they don't fall over. Sand from the riverbank beaches. Rice husks."

Interlocking soil, cement, and burlap blocks patterned after Incan construction methods made up this swimming hole's dam

Four years later, greenhouse enclosures covered a third of a square kilometer, filled with Spanish onions, tomatoes, chard, lettuce, cilantro, peas, peppers, parsley, garlic, cabbage, balm, and radishes. The Gaviotas hydroponic system used wastes from the rice farms along the Río Meta as a growing medium. The technique spread around the country, even in the flower industry. In their hydroponic nursery, they had plants germinating in trays of sawdust and wood chips. "It lets us grow food where nothing would grow before," Zapp said.

Later, Sven Zethelius actually found something that would grow in *los llanos*. Paolo had brought the idea back from Venezuela, where he'd heard an agronomist mention the hardiness of *pinus caribaea*, the tropical pine that grew in a variety of soils throughout Central America. Zethelius obtained seedlings from Guatemala, Nicara-

gua, Belize, and Honduras. So far, everything was still alive and even getting taller, with the *hondurensis* variety performing the best. Sven's little plot of foot-high, long-needle pines became a Gaviotas curiosity.

"What will we do with the pine trees?" an engineer asked him.

"Who knows? At the very least, we'll learn something from them."

Pioneer cliinc

In 1975, Oscar Gutiérrez, a doctor from Cali, Colombia, had been headed to the Amazon for a year of rural service when a chemist told him about a colleague, Sven Zethelius, who was off with a bunch of romantics trying to settle *los llanos,* like pioneers in the North American Old West. Intrigued, Oscar tracked down Paolo Lugari, who told him that the difference was that Gaviotas was helping to save the Indians, not shoot them. They had a vacant building that could serve as a clinic. "Are you ready to go?"

Gaviotas founder Paolo Lugari with a Guahibo man

A week later, a group of Guahibo Indians appeared to see the new doctor. Cases of smallpox, they said, were appearing in their village. To Gutiérrez's relief, it turned out to be measles, but he had never seen so many adults infected at once." There is no cure for measles," he said helplessly. "If a person isn't immunized, it can be fatal." Obviously, nobody here was.

Oscar Gutiérrez turned around and returned to Bogotá to seek enough vaccine to halt an epidemic. In the federal health department, they told him that none was available.

"There's no vaccine," he was told again in the Ministry of Health.

"They're dying!" he insisted.

"So what? They're Indians."

In Cartagena, he finally located four thousand doses of measles vaccine, which saved many lives, but it was too late for many others: The epidemic, which the health ministry had chosen to ignore, eventually spread all the way to Venezuela. Despite high mortality, it merited mention only in the back pages of Bogotá newspapers.

Originally at Gaviotas to fulfill his one-year rural service obligation required of all recently graduated M.D.s, Oscar Gutiérrez remained an extra year, leaving to study cardiology in Europe only after being assured that Magnus Zethelius, his former assistant who had recently earned his M.D., would replace him. Together they drew up plans for a health system, based on their experiences in the measles campaign, to deal with the great distances between the villages of *los llanos.* They wanted radios in every settlement, so Indians and *llaneros* could call the central clinic at Gaviotas for emergency instructions or an ambulance. They wanted the Gaviotas school to be a center for teaching indigeous people the rudiments of Western medicine and also a repository of the Indians' knowledge of medicinal botany.

They submitted a funding proposal to the Ministry of Health. Their work was featured in a film about Gaviotas shown at the United Nations' 1976 World Conference on Human Settlements and Habitat in Vancouver. Two years later, at the World Conference on Technical Cooperation Among Developing Countries held in Buenos Aires, Gaviotas was named the leading example of appropriate technology in the Third World. Nevertheless, the Ministry of Health rejected their proposal.

"It's unconscionable," Magnus Zethelius said.

"It's votes," Paolo replied. "In *los llanos,* there aren't any. Indians don't. Nobody would count them if they did. That's the way things work."

"I'm sick of how things work," Magnus said. "Maybe we should start our own hospital."

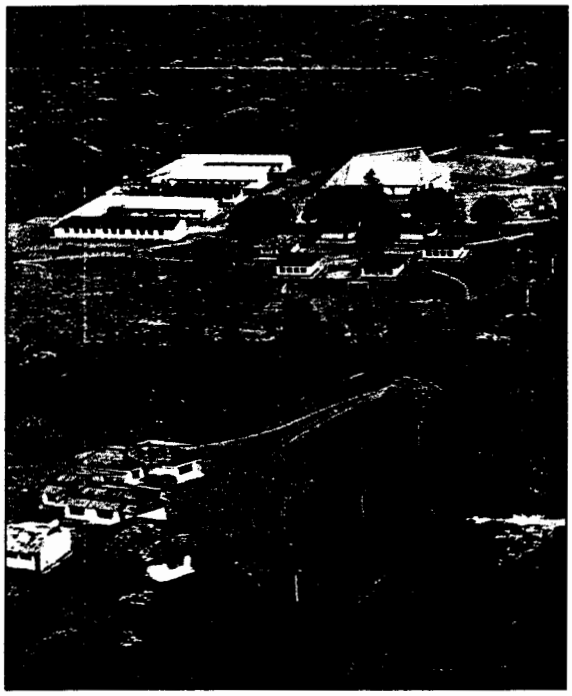
"We will," Paolo said. "We will."

NEXT ISSUE:
The UN funding for Gaviotas runs out just as oil prices plummet. With little possibility of marketing their solar collectors, the Gaviotans must find ways to become self-sufficient while coping with intrusions by the military, guerrillas, and paramilitary groups.

This adaptation and synopsis was taken from, Gaviotas!: A Village to Reinvent the World, *by Alan Weisman, copyright © 1998. We enthusiastically recommend reading this well-written, often moving book on this remarkable community. The hardcover is available through Chelsea Green Publishing Co., 205 Gates-Briggs Building, PO Box 428, White River Junction, VT 05001; 802/295-6300; Fax: 802/295-6444.*

Alan Weisman is an independent journalist who has written for numerous publications, including the Los Angeles Times Magazine. *He also co-produced a series for National Public Radio on solutions to world environmental and social problems.*

There was one thing the inventors and visionaries of Gaviotas hadn't expected when they began planting trees in the barren soils of Colombia's plains – they hadn't expected to see the rainforest come back ...



Photos: ALAN WEISMAN

¡GAVIOTAS! PART 2
OASIS OF THE IMAGINATION

Paolo Lugari, a visionary from Colombia, knew that someday the world would become so crowded that humans would have to learn to live in the planet's least desirable areas. With that in mind, he gathered some of Colombia's experts in engineering, medicine, and agriculture, along with a handful of graduate students, farmers, and "adventurous thinkers," and started a community on the arid, infertile plains of Colombia.

Soon, Gaviotas became a model of sustainability, and the appropriate technologies created by the Gaviotans – powerful solar collectors, innovative water pumps that could collect clean, safe water from the deepest aquifers, and ultralight windmills that took advantage of mild, tropical breezes – caught the attention of the United Nations, which gave the Gaviotans funding to develop more technologies and spread them throughout Latin America and the developing world.

This adaptation from the book ¡Gaviotas! A Village to Reinvent the World, *continues from YES! summer '98.*

by Alan Weisman

In Colombia in 1978, nothing was working as well as it might have. From 1958, the end of the Colombian military dictatorship, until 1974, the two opposing Colombian political parties by agreement had alternated four-year presidencies. This unified "National Front" was meant to institutionalize cooperation throughout the land.

Over nearly a generation, instead of providing credits, land, and opportunities to raise the mass of the country's population from poverty, the leaders and powerful families of each side mainly divided these among themselves. Under this transition back to "democracy," not only funds for Indian health programs, but promises made during military rule of roads and electricity for far-flung places like *los llanos,* the barren Colombian plains, became distant dreams.

As hopes for government aid receded in the hinterlands, the guerrillas grew bolder. Like an allergic reaction to overindulgence, the country found itself breaking out in heightened insurgence in various places at once.

Four years later, in 1978, a new president declared all-out war against *la guerrilla,* sanctioning what amounted to martial law throughout the land. Arbitrary arrests, torture, and assassinations became routine. But rather than suppressing opposition, the conflict only intensified.

Increasingly, the Gaviotas doctor, Magnus Zethelius, and the Guahibo Indian paramedics encountered insurgents while making their rounds through the *llanos.* The guerrillas would sometimes charge *llaneros* a protection toll while they awaited army convoys to ambush. The Gaviotas medical team was always allowed to pass, a fact that filled them both with relief and dread. The *llano* was increasingly perceived

by the military as *zona guerrilla*. All of its residents were therefore politically suspect.

Occasionally, residents awoke to find Gaviotas papered with guerrilla leaflets. Terrified, they discussed what to do. After their nearest neighbor was abducted one night by silent men with guns, some Gaviotans wondered if they should arm themselves.

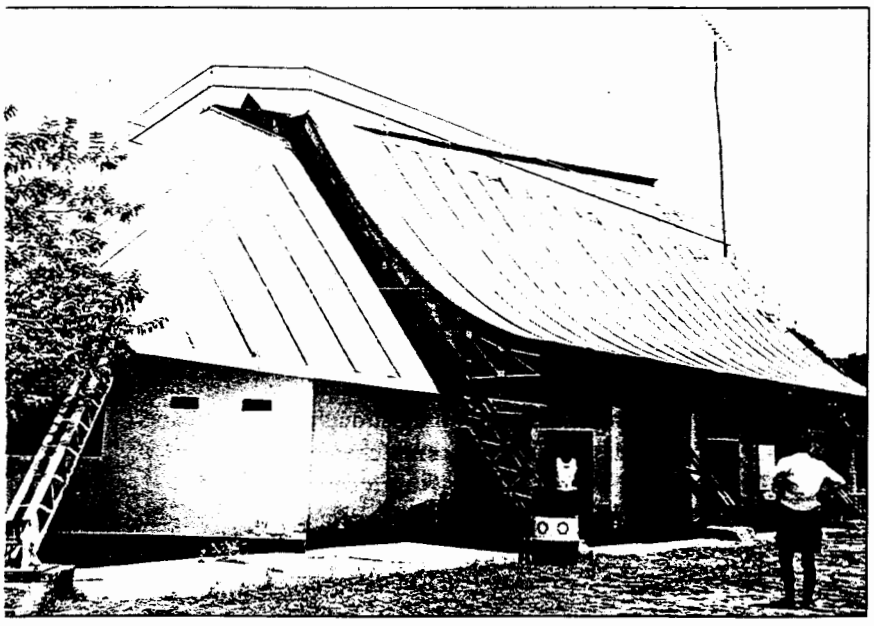
"Never," said Lugari. "The best defense is to be defenseless. Otherwise, each side will accuse us of being with the other."

They had always known that their little paradise was a fragile bloom in the harsh, uncivilized *llano*. Now, the encroaching threat to their peace seemed a far greater menace than worthless soils and man-eating insects. Their policy was never to ask who anyone was. Like the Red Cross, all factions respected Gaviotas. It became known throughout the region that no one came to Gaviotas armed. It was fair to assume that some *llaneros* who arrived to trade for corn or coffee, or who wanted to buy a pump or windmill, might be with *la guerrilla*, but they had to enter Gaviotas like any other neighbor, never carrying a weapon.

Technological wonders

After an infusion of UN funding in 1979, hospital construction proceeded – a maze of angles rising above the savanna, formed by white walls, glass awnings, skylights, brushed steel columns, floor-to-ceiling slatted-glass window blinds that opened to the breeze, and exposed metal supports finished in blue and yellow enamel. When people elsewhere asked how such apparently cold materials could fill a patient with a sense of warmth and well-being, Lugari and Zapp replied that they had to see for themselves. The hospital embodied their belief that technology could be as Thomas Edison intended it: an enrichment of human existence, not a steamroller that turned on its inventors and crushed them.

The Gaviotas hospital was built to fill patients with a sense of well-being



The central patio fountain was a film of water flowing over a one-meter cube, providing five times the evaporation surface of a conventional catch-basin to deliver cool moisture to the air. With the combination of one engineer's wind corridor and another's self-cooling roof, they all became convinced that they didn't need the subterranean ventilation used in Arabian minarets that they had planned – an idea that dated to the Egyptian pyramids. But the engineers were set on demonstrating that the concept would work. Tunneling through the hospital's perimeter terrace, they added a series of underground ducts whose hillside intakes opened to the prevailing breeze, to further freshen the interior.

The psychological healing benefits of such gadgetry were obvious, except to their Guahibo neighbors, who considered any hospital insufferable. To wall someone away from family members was, to the Guahibo, the ultimate unhealthy confinement. The Indians themselves designed and built the solution. Just beyond the infirmary, the glass-roofed solar corridor led to a short vine-covered walkway, connecting the Gaviotas hospital to a separate wing: a large square Guahibo shelter called a *maloca*. Instead of beds, indigenous patients and their families could lie in hammocks under the broad thatched roof. To earn their keep, relatives of the sick were invited to tend tomatoes, lettuce, cabbage, and onions in an adjacent hydroponic greenhouse.

Proof of success

In 1989, The United National Regional Project for Overcoming Poverty had published a three-volume set of books filled with appropriate technologies for developing societies, collected around the world by UN researchers. Gaviotas accounted for more than 50 of them, including a cork-screwing manual well-digger; parabolic solar grain dryers; rotating-drum peanut shellers; ox-drawn land graders; a manual baler that compressed hay into bricks; hot-water solar panels made from burned-out neon tubes; a pedal-powered cassava grinder that reduced 10 hours of work to one; and a one-handed sugar cane press. However, national and UN funding had run out. Plagued by guerrillas, paramilitary groups, and a murder rate that had risen to 50 per day, the Colombian government had other problems to worry about. The UN, calling Gaviotas one of its greatest successes, announced that they would no longer be funding new projects. The proof of success would be for Gaviotas to survive by itself.

Gaviotas was in agreement, but the world was not.

After the international price of oil capsized in 1986, it never returned to the heights that had prompted the initial worldwide interest in renewable energy alternatives. Sales of Gaviotas solar collectors declined.

Demand for the Gaviotas windmills also stagnated. The Gaviotans' hopes of finding new customers for windmills were frustrated by new government economic policies. Colombian farmers had discovered that, under the relaxed trade policies that George Bush's administration had enticed Colombia to adopt, they couldn't compete with a deluge of cheap grains and other foodstuffs from giant US corporate producers. It was little consolation to Colombia's devastated agricultural economy that the US ultimately paid in one way for its deft dealing, as many bankrupt farmers turned to raising one crop that no US grower could – coca.

"You would think," Paolo Lugari said to Jorge Zapp, "that with all these inventions, we should be able to make a living."

Later, when he was alone, Paolo Lugari trudged through the woodland they had planted back in 1982. Like children who seem to grow when their parents aren't watching, soil chemist Sven Zethelius's Caribbean pine seedlings, which were the only plants the Gaviotans had found that would grow in *llanos* soil, had shot up past eight feet, then 10, then 20, then still higher.

He looked around at the pines, still shooting up like giant weeds, a veritable forest where just a few years ago there was only open savanna straight to the horizon, and far beyond. These trees were nearly all that Gaviotas had left. There must be something they were supposed to do with them.

Like a huge secret, the pines loomed over him, whispering in the wind but not telling.

Planting the desert

The nursery was six shining green hectares of more than 100 raised beds, each two meters wide and 130 meters long. Together they held about 2 million seedlings. The previous year, 1995, they'd planted 2,000 new hectares (more than 5,000 acres) with 1.8 million pines.

At Gaviotas, people were prone to fiddle and experiment, and soon after they started the nursery years back, they were doing nearly everything the opposite from what conventional forestry taught. They pruned and dunked the roots in dissolved clay and then planted the trees without the conventional black plastic bags, which the Gaviotans reasoned were too hot for the tropics. No one could be sure if this were so, but eight-year-old trees in the Gaviotas forest were already taller than 50 feet, 20 percent taller than predicted heights for their age.

Nursery worker Otoniel Carreño led Gonzalo Bernal, Gaviotas' administrative coordinator, to a bed of three-year-old seedlings, left unharvested at the nursery's southern edge during an old experiment, to show him the latest felicitous infraction of conventional forestry wisdom. It was a scattering of brown puffball mushrooms, barely more than an inch across. Underground, fungi such as these form a relationship with the roots of baby pine trees, a bond as vital to the growth of the forest as a neural synapse is to the execution of a thought.

"Those," Otoniel announced, "are mycorrhiza."

"Here?" said Gonzalo. "You're kidding."

Back in 1982, Sven Zethelius had suspected that Caribbean pines would require the help of mycorrhiza to digest the *llanos* soil, and had obtained and injected dashes of desiccated fungi around the roots of the first experimental seedlings. Foresters that Gaviotas consulted confirmed that without a mycorrhiza fungus, their plantation would fail – and the fungus they needed didn't occur naturally in *los llanos*.

"We have our own mycorrhiza bank," Otoniel said. "This wasn't supposed to happen."

"Wonderful! Any idea why?"

The biggest difference between them and the Venezuelans, who had to reapply the mycorrhiza mixture repeatedly on their pine plantations, Oto speculated, was that Gaviotas wasn't using herbicides to eradicate extraneous foliage that inevitably sprang up in the pine rows. As in weeding a garden, routine forestry practice requires clearing underbrush that might compete with or actually displace the cash crop. Partly to avoid chemical sprays, partly due to cost and labor, partly out of curiosity, Gaviotas hadn't bothered to eliminate the other growth in one of their earliest experimental stands of pine. Since they weren't adding fertilizer, they reasoned that the surrounding savanna grasses might contribute some nourishment to the meager, two-centi-

meter thick soils. As the pines grew surprisingly fast, there seemed no need to weed subsequent plantings, even when all kinds of vines, shrubs, and woody plants began emerging in the moist, cool shade of the spreading pine boughs.

Several years later, they would realize how momentous this casual decision to let nature take its course would prove to be.

Gaviotan self-reliance

Once it had been established that Caribbean pines could thrive in *los llanos* where nothing else seemed to, the question facing Gaviotas was what to do with them. It was Paolo Lugari who'd spotted a newspaper article that mentioned a scarcity in Europe of natural gum colophony, the resinous ooze found under the surface of pine bark. Once again, Gaviotas set to experimenting. At the end of 36 days, their yield of golden resin from their eight-year-old trees was, according to the manuals, what they should be getting from trees 25 years old.

In Colombia alone, companies making paints and varnishes had been importing 4 million dollars' worth of pine resin a year. "Not any more," Lugari told a meeting of all Gaviotans. Their Caribbean pines had turned out to be veritable nutrient pumps. Best of all, the resin was renewable. Otoniel explained that it wasn't the sap they were drawing, but a fluid produced by the bark that acted like a natural insecticide. They could safely tap a pine for at least eight years, then rest the tree for another eight years, then begin again. This would mean never having to chop their forest down in order to make a living from it. And when they heated raw resin to purify it, the residue was another marketable by-product: clear turpentine.

Gaviotans harvest resin from the Caribbean pine trees they planted as part of a reforestation experiment

But first, Gaviotas had to find the money to put themselves in business. They needed equipment to extract the resin, land to expand their forest – in short, the sort of strategic investment and financial planning that Gaviotas, with its tradition of applied chaos and spontaneity, was not inclined to undertake. But to survive, Paolo Lugari told his people and himself, they had to be flexible, not rigid, even about being spontaneous.

Putting back the rainforest

Gaviotas sent a proposal to the Inter-American Development Bank, which managed several international development funds inclined to help nurture good, hopeful ideas toward fruition. While considering the proposal, loan officer Joel Korn went to see Gaviotas for himself.

Korn was stunned by the hospital in the middle of nowhere that combined ultra-modern mechanisms with indigenous customs. The cheerful Gaviotas school charmed him. The notion of a sustainable civilization in the hitherto-neglected savanna made wonderful sense to him, as he imagined it would to the board of one of the development funds as well.

Paolo pointed through the pines at a doe and a fawn. "We're seeing wildlife in this forest that had nearly disappeared," he whispered. "Deer, anteaters, armadillos, eagles. But especially –" he said, indicating the tangle of vines he was disengaging from his ankle, "– all this."

All around them, interspersed among the pines, grew shrubs with crimson flowers, wispy jacarandas, paper-barked white saplings called *tuno blancos*, and wild fig vines. Lugari explained that a pair of biologists had begun compiling a list of dozens of species sprouting in the moist understory of the Gaviotas pine forest, where formerly there were only a few kinds of grasses. No one knew yet if these were from dormant seeds of native trees not seen on the savanna for millennia, or if birds were sowing seeds from the gallery forests here with their droppings. Either way, the reforestation was unprecedented: sheltered by Caribbean pine trees, a diverse, indigenous tropical forest was either regenerating or being replanted in *los llanos* with surprising speed.

"The native plants don't hurt the pines?" Korn asked.

"We think to the contrary," Paolo said. "The biologists believe this is a much healthier forest than the plantations in Venezuela because it's not a monoculture. Our trees grow and mature faster than theirs."

"Amazing."

"Still, we expect that one day the tropical foliage will overrun them. Sven tells us that we can harvest resin for decades until the natural forest chokes out the Caribbean pines. If you help us take our agro-forestry project to a commercial level, we can keep marching across the savanna, planting more pine trees, and leaving a tropical rain forest in our wake. We can give seedlings to all our neighbors, process their resin, turn this desert into a productive land, employ *campesinos* and the Guahibo, and at the same time return the *llanos* to what Sven says many ecologists believe was their pri-

Everywhere else they're tearing down the rain forests. We're showing how to put them back

A nursery worker finds dramatic changes in the soil and plant life on the forest floor of reforested areas

meval state: an extension of the Amazon. Imagine that!

"There are 250 million hectares of savannas like these in South America alone. There's Africa. The tropical Orient. Places where there's space and sun and water. If we show the world how to plant them in sustainable forests, we can give people productive lives and maybe absorb enough carbon dioxide to stabilize global warming in the process. Everywhere else they're tearing down the rain forests. We're showing how to put them back."

A heroic stand

The resin factory would eventually process 20 tons of *colofonia* per day. But everything depended on getting enough new trees in the ground so that over the next decade both production and their human population could expand.

According to their newly won contract with the Inter-American Development Bank, they had to plant at least 2,000 hectares by the end of the year – nearly a million trees. But they were way behind, because 1994 had proved the wettest year in Colombian history. They lost a whole month saving the nursery from severe erosion that threatened to destroy a million seedlings.

Now, Paolo was telling everyone at Gaviotas that another heroic stand was needed. Lugari had managed to procure another grant through a government forestry incentive program that would pay them to sow an additional 1,500 hectares of pines over three years. "But no more money comes in until we actually get all the seedlings transplanted permanently in the savanna. I can't ask you to work again for delayed pay. It's up to you to decide if you want to do this."

One Gaviotan stood up. "This forest is our future. Our lungs are out there. We're breathing oxygen that Dr. Zethelius planted 10 years ago. I want to be around in 10 more years to harvest what we're planting."

Hernan Landaeta, the *colofonia* factory director, was next. "We brought water to the *llano*. Now it's time to bring trees."

It took 24 days, working 24 hours around the clock, never stopping. Never in Colombian history, they told each other, had an entire village worked all night like that. Especially because every night, it rained.

They had to finish before the rains slackened in October, because the seedlings and the mycorrhiza required moisture. They divided into 12-hour shifts, one beginning at dawn, one at dusk. By day, the schoolchildren helped; by night came women who weren't on the regular crew. Lunch was served once at noon, once at midnight.

Another month went by with no salaries. No one missed work, or was even late. No one complained. The tractors stayed tuned, the meals arrived hot, and when they finished, 2,000 hectares and a million trees later, they slaughtered a steer and stayed up one more night, eating *carne asada* and drinking sweet *aguardiente* and dancing in the community hall and right out the doors, onto the soccer field and under the rain, to the music of harps and *cuatros* and *bandolas*, toasting each other for never giving up.

Today, Gaviotas continues to advance. Besides paints, enamels, and varnish, the Gaviotans found that natural colofonia can be used in soap, ink, newsprint, cosmetics, perfume esters, drying agents, medicines, and to rosin the bows of musical instruments. The resin factory's boiler, fueled by culls from their own forest, has been tuned successfully to emit no visible smoke, and it now runs on a co-generating two-cylinder steam engine, making Gaviotas at last self-sufficient in energy. As a result, Gaviotas was awarded the 1997 World Prize in Zero Emissions from ZERI, the United Nations' Zero Emissions Research Initiative.

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***Alan Weisman** is an independent journalist who has written for numerous publications, including the Los Angeles Times Magazine, of which he is a contributing editor. He also co-produced a series for National Public Radio on solutions to world environmental and social problems.*