ELEVEN

THE ANIMALS

Practicing Complexity

1. TUESDAY MORNING

It's not often I wake up at six in the morning to discover I've overslept, but by the time I had hauled my six-foot self out of the five-foot bed in Lucille's microscopic guest room, everyone was already gone and morning chores were nearly done. Shockingly, chores at Polyface commence as soon as the sun comes up (five-ish this time of year) and always before breakfast. Before coffee, that is, not that there was a drop of it to be had on this farm. I couldn't recall the last time I'd even attempted to do anything consequential before breakfast, or before caffeine at the very least.

When I stepped out of the trailer into the warm early morning mist, I could make out two figures—the interns, probably—moving around up on the broad shoulder of hill to the east, where a phalanx of portable chicken pens formed a checkerboard pattern on the grass. Among other things, morning chores consist of feeding and watering the broilers and moving their pens one length down the hillside. I was

supposed to be helping Galen and Peter do this, so I started up the path, somewhat groggily, hoping to get there before they finished.

As I stumbled up the hill, I was struck by how very beautiful the farm looked in the hazy early light. The thick June grass was silvered with dew, the sequence of bright pastures stepping up the hillside dramatically set off by broad expanses of blackish woods. Birdsong stitched the thick blanket of summer air, pierced now and again by the wood clap of chicken pen doors slamming shut. It was hard to believe this hillside had ever been the gullied wreck Joel had described at dinner, and even harder to believe that farming such a damaged landscape so intensively, rather than just letting it be, could restore it to health and yield this beauty. This is not the environmentalist's standard prescription. But Polyface is proof that people can sometimes do more for the health of a place by cultivating it rather than by leaving it alone.

By the time I reached the pasture Galen and Peter had finished moving the pens. Fortunately they were either too kind or too timid to give me a hard time for oversleeping. I grabbed a pair of water buckets, filled them from the big tub in the center of the pasture, and lugged them to the nearest pen. Fifty of these pens were spread out across the damp grass in a serrated formation that had been calibrated to cover every square foot of this meadow in the course of the fifty-six days it takes a broiler to reach slaughter weight; the pens moved ten feet each day, the length of one pen. Each ten-by-twelve, two-foot-tall floorless pen houses seventy birds. A section of the roof is hinged to allow access, and a five-gallon bucket perched atop each unit feeds a watering device suspended inside.

Directly behind each pen was a perfectly square patch of closely cropped grass resembling a really awful Jackson Pollock painting, thickly spattered with chicken crap in pigments of white, brown, and green. It was amazing what a mess seventy chickens could make in a day. But that was the idea: Give them twenty-four hours to eat the grass and fertilize it with their manure, and then move them onto fresh ground.

Joel developed this novel method for raising broiler chickens in the 1980s and popularized it in his 1993 book, *Pastured Poultry Profit$*, some-

thing of a cult classic among grass farmers. (Joel has self-published other how-to books on farming, and all but one of them has a ping in for an S somewhere in its title.) Left to their own devices, fined flock of chickens will eventually destroy any patch of land pecking the grass down to its roots and poisoning the soil with extremely "hot," or nitrogenous, manure. This is why the typical range chicken yard quickly winds up bereft of plant life and brick. Moving the birds daily keeps both the land and the birds the broilers escape their pathogens and the varied diet of greens plies most of their vitamins and minerals. The birds also get a corn, toasted soybeans, and kelp, which we scooped into long in their pens, but Joel claims the fresh grass, along with the grasshoppers, and crickets they peck out of the grass, provides as as 20 percent of their diet—a significant savings to the farmer boon to the birds. Meanwhile, their manure fertilizes the grass, ing all the nitrogen it needs. The chief reason Polyface Farm is pletely self-sufficient in nitrogen is that a chicken, defecating pays a visit to virtually every square foot of it at several points during season. Apart from some greensand (a mineral supplement to calcium lost in the meadows), chicken feed is the only important Joel buys, and the sole off-farm source of fertility. ("The way I look at I'm just returning some of the grain that's been extracted from this over the last 150 years.") The chicken feed not only feeds the but, transformed into chicken crap, feeds the grass that feeds the that, as I was about to see, feed the pigs and the laying hens.

After we had finished watering and feeding the broilers, I headed up to the next pasture, where I could hear a tractor idling. Galen had told me Joel was moving the Eggmobile, an operation I'd been eager to watch. The Eggmobile, one of Joel's proudest innovations, is a ramshackle cross between a henhouse and a prairie schooner. Housing four hundred laying hens, this rickety old covered wagon has hinged nesting boxes lined up like saddlebags on either side, allowing someone to retrieve eggs from the outside. I'd first laid eyes on the Eggmobile the night before, parked a couple of paddocks away from the cattle herd.

hens had already climbed the little ramp into the safety of the coop the night, and before we went down to dinner Joel had latched the behind them. Now it was time to move them into a fresh pad- and Joel was bolting the Eggmobile to the hitch of his tractor. It quite 7:00 A.M. yet, but Joel seemed delighted to have someone to, holding forth being one of his greatest pleasures.

"In nature you'll always find birds following herbivores," Joel ex- when I asked him for the theory behind the Eggmobile. "The perched on the rhino's nose, the pheasants and turkeys trailing af- the bison—that's a symbiotic relationship we're trying to imitate." each case the birds dine on the insects that would otherwise bother herbivore; they also pick insect larvae and parasites out of the ani- droppings, breaking the cycle of infestation and disease. "To this symbiosis on a domestic scale, we follow the cattle in their with the Eggmobile. I call these gals our sanitation crew."

Joel climbed onto the tractor, threw it into gear, and slowly towed rickety contraption fifty yards or so across the meadow to a pad- the cattle had vacated three days earlier. It seems the chickens es- fresh manure, so he waits three or four days before bringing them in—but not a day longer. That's because the fly larvae in the ma- are on a four-day cycle, he explained. "Three days is ideal. That the grubs a chance to fatten up nicely, the way the hens like them, not quite long enough to hatch into flies." The result is prodigious amounts of protein for the hens, the insects supplying as much as a third of their total diet—and making their eggs unusually rich and tasty. By means of this simple little management trick, Joel is able to use his cattle's waste to "grow" large quantities of high-protein chicken feed for free; he says this trims his cost of producing eggs by twenty-five cents per dozen. (Very much his accountant father's son, Joel can tell you the exact economic implication of every synergy on the farm.) The cows further oblige the chickens by shearing the grass; chickens can't navigate in grass more than about six inches tall.

After Joel had maneuvered the Eggmobile into position, he opened the trapdoor, and an eager, gossipy procession of Barred Rocks, Rhode

Island Reds, and New Hampshire Whites filed down the little ramp, fanning out across the pasture. The hens picked at the grasses, especially the clover, but mainly they were all over the cowpats, doing this frantic backward-stepping break-dance with their claws to scratch apart the caked manure and expose the meaty morsels within. Unfolding here before us, I realized, was a most impressive form of alchemy: cowpatties in the process of being transformed into exceptionally tasty eggs.

"I'm convinced an Eggmobile would be worth it even if the chickens never laid a single egg. These birds do a more effective job of sanitizing a pasture than anything human, mechanical, or chemical, and the chickens love doing it." Because of the Eggmobile, Joel doesn't have to run his cattle through a headgate to slather Ivomectrin, a systemic parasiticide, on their hides or worm them with toxic chemicals. This is what Joel means when he says the animals do the real work around here. "I'm just the orchestra conductor, making sure everybody's in the right place at the right time."

THAT DAY, my second on the farm, as Joel introduced me to each of his intricately layered enterprises, I began to understand just how radically different this sort of farming is from the industrial models I'd observed before, whether in an Iowa cornfield or an organic chicken farm in California. Indeed, it is so different that I found Polyface's system difficult to describe to myself in an orderly way. Industrial processes follow a clear, linear, hierarchical logic that is fairly easy to put into words, probably because words follow a similar logic: First this, then that; put this in here, and then out comes that. But the relationship between cows and chickens on this farm (leaving aside for the moment the other creatures and relationships present here) takes the form of a loop rather than a line, and that makes it hard to know where to start, or how to distinguish between causes and effects, subjects and objects.

Is what I'm looking at in this pasture a system for producing exceptionally tasty eggs? If so, then the cattle and their manure are a means to an end. Or is it a system for producing grass-fed beef without the use

of any chemicals, in which case the chickens, by fertilizing and sanitizing the cow pastures, comprise the means to that end? So does that make their eggs a product or a by-product? And is manure—theirs or the cattle's—a waste product or a raw material? (And what should we call the fly larvae?) Depending on the point of view you take—that of the chicken, the cow, or even the grass—the relationship between subject and object, cause and effect, flips.

Joel would say this is precisely the point, and precisely the distinction between a biological and an industrial system. "In an ecological system like this everything's connected to everything else, so you can't change one thing without changing ten other things.

"Take the issue of scale. I could sell a whole lot more chickens and eggs than I do. They're my most profitable items, and the market is telling me to produce more of them. Operating under the industrial paradigm, I could boost production however much I wanted—just buy more chicks and more feed, crank up that machine. But in a biological system you can never do just one thing, and I couldn't add many more chickens without messing up something else.

"Here's an example: This pasture can absorb four hundred units of nitrogen a year. That translates into four visits from the Eggmobile or two passes of a broiler pen. If I ran any more Eggmobiles or broiler pens over it, the chickens would put down more nitrogen than the grass could metabolize. Whatever the grass couldn't absorb would run off, and suddenly I have a pollution problem." Quality would suffer, too: Unless he added more cattle, to produce more grubs for the chickens and to keep the grass short enough for them to eat it, those chickens and eggs would not taste nearly as good as they do.

"It's all connected. This farm is more like an organism than a machine, and like any organism it has its proper scale. A mouse is the size of a mouse for a good reason, and a mouse that was the size of an elephant wouldn't do very well."

Joel likes to quote from an old agricultural textbook he dug out of the stacks at Virginia Tech many years ago. The book, which was published in 1941 by a Cornell Ag professor, offers a stark conclusion that,

depending on your point of view, will sound either hopelessly quaint or arresting in its gnomic wisdom: "Farming is not adapted to large-scale operations because of the following reasons: Farming is concerned with plants and animals that live, grow, and die."

"EFFICIENCY" is the term usually invoked to defend large-scale industrial farms, and it usually refers to the economies of scale that can be achieved by the application of technology and standardization. Yet Joel Salatin's farm makes the case for a very different sort of efficiency—the one found in natural systems, with their coevolutionary relationships and reciprocal loops. For example, in nature there is no such thing as a waste problem, since one creature's waste becomes another creature's lunch. What could be more efficient than turning cow pies into eggs? Or running a half-dozen different production systems—cows, broilers, layers, pigs, turkeys—over the same piece of ground every year?

Most of the efficiencies in an industrial system are achieved through simplification: doing lots of the same thing over and over. In agriculture, this usually means a monoculture of a single animal or crop. In fact, the whole history of agriculture is a progressive history of simplification, as humans reduced the biodiversity of their landscapes to a small handful of chosen species. (Wes Jackson calls our species "homo the homogenizer.") With the industrialization of agriculture, the simplifying process reached its logical extreme—in monoculture. This radical specialization permitted standardization and mechanization, leading to the leaps in efficiency claimed by industrial agriculture. Of course, how you choose to measure efficiency makes all the difference, and industrial agriculture measures it, simply, by the yield of one chosen species per acre of land or farmer.

By contrast, the efficiencies of natural systems flow from complexity and interdependence—by definition the very opposite of simplification. To achieve the efficiency represented by turning cow manure into chicken eggs and producing beef without chemicals you need at least two species (cows and chickens), but actually several more as well,

including the larvae in the manure and the grasses in the pasture and the bacteria in the cows' rumens. To measure the efficiency of such a complex system you need to count not only all the products it produces (meat, chicken, eggs) but also all the costs it eliminates: antibiotics, wormers, parasiticides, and fertilizers.

Polyface Farm is built on the efficiencies that come from mimicking relationships found in nature and layering one farm enterprise over another on the same base of land. In effect, Joel is farming in time as well as in space—in four dimensions rather than three. He calls this intricate layering "stacking" and points out that "it is exactly the model God used in building nature." The idea is not to slavishly imitate nature, but to model a natural ecosystem in all its diversity and interdependence, one where all the species "fully express their physiological distinctiveness." He takes advantage of each species' natural proclivities in a way that benefits not only that animal but other species as well. So instead of treating the chicken as a simple egg or protein machine, Polyface honors—and exploits—"the innate distinctive desires of a chicken," which include pecking in the grass and cleaning up after herbivores. The chickens get to do, and eat, what they evolved to do and eat, and in the process the farmer and his cattle both profit. What is the opposite of zero-sum? I'm not sure, but this is it.

Joel calls each of his stacked farm enterprises a "holon," a word I'd never encountered before. He told me he picked it up from Allan Nation; when I asked Nation about it, he pointed me to Arthur Koestler, who coined the term in *The Ghost in the Machine*. Koestler felt English lacked a word to express the complex relationship of parts and wholes in a biological or social system. A holon (from the Greek *holos*, or whole, and the suffix *on*, as in proton, suggesting a particle) is an entity that from one perspective appears a self-contained whole, and from another a dependent part. A body organ like the liver is a holon; so is an Eggmobile.

At any given time, Polyface has a dozen or more holons up and running, and on my second day Joel and Daniel introduced me to a handful of them. I visited the Raken House, the former toolshed where

Daniel has been raising rabbits for the restaurant trade since he was ten. ("Raken?" "Half rabbit, half chicken," Daniel explained.) When the rabbits aren't out on the pasture in portable hutches, they live in cages suspended over a deep bedding of woodchips, in which I watched several dozen hens avidly pecking away in search of earthworms. Daniel explained that the big problem in raising rabbits indoors is their powerful urine, which produces so much ammonia that it scars their lungs and leaves them vulnerable to infection. To cope with the problem most rabbit farmers add antibiotics to their feed. But the scratching of the hens turns the nitrogenous rabbit pee into the carbonaceous bedding, creating a rich compost teeming with earthworms that feed the hens. Drugs become unnecessary and, considering how many rabbits and chickens lived in it, the air in the Raken was, well, tolerable. "Believe me," Daniel said, "if it weren't for these chickens, you'd be gagging right about now, and your eyes would sting something awful."

Before lunch I helped Galen and Peter move the turkeys, another holon. Moving the turkeys, which happens every three days, means setting up a new "feathernet"—a paddock outlined by portable electric fencing so lightweight I could carry and lay out the entire thing by myself—and then wheeling into it the shademobile, called the Gobbledy-Go. The turkeys rest under the Gobbledy-Go by day and roost on top of it at night. They happily follow the contraption into the fresh pasture to feast on the grass, which they seemed to enjoy even more than the chickens do. A turkey consumes a long blade of grass by neatly folding it over and over again with its beak, as if making origami. Joel likes to run his turkeys in the orchard, where they eat the bugs, mow the grass, and fertilize the trees and vines. (Turkeys will eat much more grass than chickens, and they don't damage crops the way chickens can.) "If you run turkeys in a grape orchard," Joel explained, "you can afford to stock the birds at only seventy percent of normal density, and space the vines at seventy percent of what's standard, because you're getting two crops off the same land. And at seventy percent you get much healthier birds and grapevines than you would at one hundred percent. That's the beauty of stacking." By industry standards, the turkey and grape holons are each less than 100 percent efficient; together, however, they produce more than either enterprise would yield if fully stocked, and they do so without fertilizer, weeding, or pesticide.

I had witnessed one of the most winning examples of stacking in the cattle barn during my first visit to Polyface back in March. The barn is an unfancy open-sided structure where the cattle spend three months during the winter, each day consuming twenty-five pounds of hay and producing fifty pounds of manure. (Water makes up the difference.) But instead of regularly mucking out the barn, Joel leaves the manure in place, every few days covering it with another layer of woodchips or straw. As this layer cake of manure, woodchips, and straw gradually rises beneath the cattle, Joel simply raises the adjustable feed gate from which they get their ration of hay; by winter's end the bedding, and the cattle, can be as much as three feet off the ground. There's one more secret ingredient Joel adds to each layer of this cake: a few bucketfuls of corn. All winter long the layered bedding composts, in the process generating heat to warm the barn (thus reducing the animals' feed requirements), and fermenting the corn. Joel calls it his cattle's electric blanket.

Why the corn? Because there's nothing a pig enjoys more than forty-proof corn, and there's nothing he's better equipped to do than root it out with his powerful snout and exquisite sense of smell. "I call them my pigaerators," Salatin said proudly as he showed me into the barn. As soon as the cows head out to pasture in the spring, several dozen pigs come in, proceeding systematically to turn and aerate the compost in their quest for kernels of alcoholic corn. What had been an anaerobic decomposition suddenly turns aerobic, which dramatically heats and speeds up the process, killing any pathogens. The result, after a few weeks of pigaerating, is a rich, cakey compost ready to use.

"This is the sort of farm machinery I like: never needs its oil changed, appreciates over time, and when you're done with it you eat it." We were sitting on the rail of a wooden paddock, watching the pigs do their thing—a thing, of course, we weren't having to do ourselves. The line about the pigaerators was obviously well-worn. But the cliché that kept banging around in my head was "happy as a pig in shit."

Buried clear to their butts in composting manure, a bobbing sea of wriggling hams and corkscrew tails, these were the happiest pigs I'd ever seen.

I couldn't look at their spiraled tails, which cruised above the earthy mass like conning towers on submarines, without thinking about the fate of pigtails in industrial hog production. Simply put, there *are* no pigtails in industrial hog production. Farmers "dock," or snip off, the tails at birth, a practice that makes a certain twisted sense if you follow the logic of industrial efficiency on a hog farm. Piglets in these CAFOs are weaned from their mothers ten days after birth (compared with thirteen weeks in nature) because they gain weight faster on their drug-fortified feed than on sow's milk. But this premature weaning leaves the pigs with a lifelong craving to suck and chew, a need they gratify in confinement by biting the tail of the animal in front of them. A normal pig would fight off his molester, but a demoralized pig has stopped caring. "Learned helplessness" is the psychological term, and it's not uncommon in CAFOs, where tens of thousands of hogs spend their entire lives ignorant of earth or straw or sunshine, crowded together beneath a metal roof standing on metal slats suspended over a septic tank. It's not surprising that an animal as intelligent as a pig would get depressed under these circumstances, and a depressed pig will allow his tail to be chewed on to the point of infection. Since treating sick pigs is not economically efficient, these underperforming production units are typically clubbed to death on the spot.

Tail docking is the USDA's recommended solution to the porcine "vice" of tail chewing. Using a pair of pliers and no anesthetic, most—but not quite all—of the tail is snipped off. Why leave the little stump? Because the whole point of the exercise is not to remove the object of tail biting so much as to render it even more sensitive. Now a bite to the tail is so painful that even the most demoralized pig will struggle to resist it. Horrible as it is to contemplate, it's not hard to see how the road to such a hog hell is smoothly paved with the logic of industrial efficiency.

A very different concept of efficiency sponsors the hog heaven on display here in Salatin's barn, one predicated on what he calls "the pigness of the pig." These pigs too were being exploited—in this case, tricked into making compost as well as pork. What distinguishes Salatin's system is that it is designed around the natural predilections of the pig rather than around the requirements of a production system to which the pigs are then conformed. Pig happiness is simply the by-product of treating a pig as a pig rather than as "a protein machine with flaws"—flaws such as pigtails and a tendency, when emiserated, to get stressed.

Salatin reached down deep where his pigs were happily rooting and brought a handful of fresh compost right up to my nose. What had been cow manure and woodchips just a few weeks before now smelled as sweet and warm as the forest floor in summertime, a miracle of transubstantiation. As soon as the pigs complete their alchemy, Joel will spread the compost on his pastures. There it will feed the grasses, so the grasses might again feed the cows, the cows the chickens, and so on until the snow falls, in one long, beautiful, and utterly convincing proof that in a world where grass can eat sunlight and food animals can eat grass, there is indeed a free lunch.

2. TUESDAY AFTERNOON

After our own quick lunch (ham salad and deviled eggs), Joel and I drove to town in his pickup to make a delivery and take care of a few errands. It felt sweet to be sitting down for a while, especially after a morning taken up with loading the hay we'd baled the day before into the hayloft. For me this rather harrowing operation involved attempting to catch fifty-pound bales that Galen tossed in my general direction from the top of the hay wagon. The ones that didn't completely knock me over I hoisted onto a conveyor belt that carried them to Daniel and Peter, stationed up in the hayloft. It was an assembly line, more or less, and as soon as I fell behind (or just fell, literally) the hay bales piled up fast at my station; I felt like Lucille Ball at the candy factory. I joked to Joel that, contrary to his claims that the animals did most of the real work on this farm, it seemed to me they'd left plenty of it for us.

On a farm, complexity sounds an awful lot like hard work, Joel's claims to the contrary notwithstanding. As much work as the animals do, that's still us humans out there moving the cattle every evening, dragging the broiler pens across the field before breakfast (something I'd pledged I'd wake up in time for the next day), and towing chicken coops hither and yon according to a schedule tied to the life cycle of fly larvae and the nitrogen load of chicken manure. My guess is that there aren't too many farmers today who are up for either the physical or mental challenge of this sort of farming, not when industrializing promises to simplify the job. Indeed, a large part of the appeal of industrial farming is its panoply of labor- and thought-saving devices: machines of every description to do the physical work, and chemicals to keep crops and animals free from pests with scarcely a thought from the farmer. George Naylor works his fields maybe fifty days out of the year; Joel and Daniel and two interns are out there every day sunrise to sunset for a good chunk of the year.

Yet Joel and Daniel plainly relish their work, partly because it is so varied from day to day and even hour to hour, and partly because they find it endlessly interesting. Wendell Berry has written eloquently about the intellectual work that goes into farming well, especially into solving the novel problems that inevitably crop up in a natural system as complex as a farm. You don't see much of this sort of problem-solving in agriculture today, not when so many solutions come ready-made in plastic bottles. So much of the intelligence and local knowledge in agriculture has been removed from the farm to the laboratory, and then returned to the farm in the form of a chemical or machine. "Whose head is the farmer using?" Berry asks in one of his essays. "Whose head is using the farmer?"

"Part of the problem is, you've got a lot of D students left on the farm today," Joel said, as we drove around Staunton running errands. "The guidance counselors encouraged all the A students to leave home and go to college. There's been a tremendous brain drain in rural America. Of course that suits Wall Street just fine; Wall Street is always trying to extract brainpower and capital from the countryside. First they take the brightest bulbs off the farm and put them to work in Dilbert's cubicle, and then they go after the capital of the dimmer ones who stayed behind, by selling them a bunch of gee-whiz solutions to their problems." This isn't just the farmer's problem, either. "It's a foolish culture that entrusts its food supply to simpletons."

It isn't hard to see why there isn't much institutional support for the sort of low-capital, thought-intensive farming Joel Salatin practices: He buys next to nothing. When a livestock farmer is willing to "practice complexity"—to choreograph the symbiosis of several different animals, each of which has been allowed to behave and eat as it evolved to—he will find he has little need for machinery, fertilizer, and, most strikingly, chemicals. He finds he has no sanitation problem or any of the diseases that result from raising a single animal in a crowded monoculture and then feeding it things it wasn't designed to eat. This is perhaps the greatest efficiency of a farm treated as a biological system: health.

I was struck by the fact that for Joel abjuring agrochemicals and pharmaceuticals is not so much a goal of his farming, as it so often is in organic agriculture, as it is an indication that his farm is functioning well. "In nature health is the default," he pointed out. "Most of the time pests and disease are just nature's way of telling the farmer he's doing something wrong."

At Polyface no one ever told me not to touch the animals, or asked me to put on a biohazard suit before going into the brooder house. The reason I had to wear one at Petaluma Poultry is because that system—a monoculture of chickens raised in close confinement—is inherently precarious, and the organic rules' prohibition on antibiotics puts it at a serious disadvantage. Maintaining a single-species animal farm on an industrial scale isn't easy without pharmaceuticals and pesticides. Indeed, that's why these chemicals were invented in the first place, to keep shaky monocultures from collapsing. Sometimes the large-scale organic farmer looks like someone trying to practice industrial agriculture with one hand tied behind his back.

By the same token, a reliance on agrochemicals destroys the infor-

mation feedback loop on which an attentive farmer depends to improve his farming. "Meds just mask genetic weaknesses," Joel explained one afternoon when we were moving the cattle. "My goal is always to improve the herd, adapt it to the local conditions by careful culling. To do this I need to know: Who has a propensity for pinkeye? For worms? You simply have no clue if you're giving meds all the time."

"So you tell me, who's really in this so-called information economy? Those who learn from what they observe on their farm, or those who rely on concoctions from the devil's pantry?"

Of course the simplest, most traditional measure of a farm's efficiency is how much food it produces per unit of land; by this yardstick too Polyface is impressively efficient. I asked Joel how much food Polyface produces in a season, and he rattled off the following figures:

30,000 dozen eggs
12,000 broilers
800 stewing hens
50 beeves (representing 25,000 pounds of beef)
250 hogs (50,000 pounds of pork)
800 turkeys
500 rabbits.

This seemed to me a truly astonishing amount of food from one hundred acres of grass. But when I put it that way to Joel that afternoon—we were riding the ATV up to the very top of the hill to visit the hogs in their summer quarters—he questioned my accounting method. It was far too simple.

"Sure, you can write that we produced all that food from a hundred open acres, but if you really want to be accurate about it, then you've got to count the four hundred and fifty acres of woodlot too." I didn't get that at all. I knew the woodlot was an important source of farm income in the winter—Joel and Daniel operate a small sawmill from

which they sell lumber and mill whatever wood they need to build sheds and barns (and Daniel's new house). But what in the world did the forest have to do with producing food?

Joel proceeded to count the ways. Most obviously, the farm's water supply depended on its forests to hold moisture and prevent erosion. Many of the farm's streams and ponds would simply dry up if not for the cover of trees. Nearly all of the farm's 550 acres had been deforested when the Salatins arrived; one of the first things Bill Salatin did was plant trees on all the north-facing slopes.

"Feel how cool it is in here." We were passing through a dense stand of oak and hickory. "Those deciduous trees work like an air conditioner. That reduces the stress on the animals in summer."

Suddenly we arrived at a patch of woodland that looked more like a savanna than a forest: The trees had been thinned and all around them grew thick grasses. This was one of the pig paddocks that Joel had carved out of the woods with the help of the pigs themselves. "All we do to make a new pig paddock is fence off a quarter acre of forest, thin out the saplings to let in some light, and then let the pigs do their thing." Their thing includes eating down the brush and rooting around in the stony ground, disturbing the soil in a way that induces the grass seed already present to germinate. Within several weeks, a lush stand of wild rye and foxtail emerges among the trees, and a savanna is born. Shady and cool, this looked like ideal habitat for the sunburn-prone pigs, who were avidly nosing through the tall grass and scratching their backs against the trees. There is something viscerally appealing about a savanna, with its pleasing balance of open grass and trees, and something profoundly heartening about the idea that, together, farmer and pigs could create such beauty here in the middle of a brushy second-growth forest.

But Joel wasn't through counting the benefits of woodland to a farm; idyllic pig habitat was the least of it.

"There's not a spreadsheet in the world that can measure the value of maintaining forest on the northern slopes of a farm. Start with those trees easing the swirling of the air in the pastures. That might not seem like a

big deal, but it reduces evaporation in the fields—which means more water for the grass. Plus, a grass plant burns up fifteen percent of its calories just defying gravity, so if you can stop it from being wind whipped you greatly reduce the energy it uses keeping its photovoltaic array pointed toward the sun. More grass for the cows. That's the efficiency of a hedgerow surrounding a small field, something every farmer used to understand before 'fencerow to fencerow' became USDA mantra."

Then there is the water-holding capacity of trees, he explained, which on a north slope literally pumps water uphill. Next was all the ways a forest multiplies a farm's biodiversity. More birds on a farm mean fewer insects, but most birds won't venture more than a couple hundred yards from the safety of cover. Like many species, their preferred habitat is the edge between forest and field. The biodiversity of the forest edge also helps control predators. As long as the weasels and coyotes have plenty of chipmunks and voles to eat, they're less likely to venture out and prey on the chickens.

There was more. On a steep northern slope trees will produce much more biomass than will grass. "We're growing carbon in the woods for the rest of the farm—not just the firewood to keep us warm in the winter, but also the wood chips that go into making our compost." Making good compost depends on the proper ratio of carbon to nitrogen; the carbon is needed to lock down the more volatile nitrogen. It takes a lot of wood chips to compost chicken or rabbit waste. So the carbon from the woodlots feeds the fields, finding its way into the grass and, from there, into the beef. Which it turns out is not only grass fed but tree fed as well.

These woods represented a whole other order of complexity that I had failed to take into account. I realized that Joel didn't look at this land the same way I did, or had before this afternoon: as a hundred acres of productive grassland patchworked into four hundred and fifty acres of unproductive forest. It was all of a biological piece, the trees and the grasses and the animals, the wild and the domestic, all part of a single ecological system. By any conventional accounting, the forests here represented a waste of land that could be put to productive use.

But if Joel were to cut down the trees to graze more cattle, as any conventional accounting would recommend, the system would no longer be quite as whole or as healthy as it is. *You can't just do one thing.*

For some reason the image that stuck with me from that day was that slender blade of grass in a too-big, wind-whipped pasture, burning all those calories just to stand up straight and keep its chloroplasts aimed at the sun. I'd always thought of the trees and grasses as antagonists—another zero-sum deal in which the gain of the one entails the loss of the other. To a point, this is true: More grass means less forest; more forest less grass. But either-or is a construction more deeply woven into our culture than into nature, where even antagonists depend on one another and the liveliest places are the edges, the in-betweens or both-ands. So it is with the blade of grass and the adjacent forest as, indeed, with all the species sharing this most complicated farm. Relations are what matter most, and the health of the cultivated turns on the health of the wild. Before I came to Polyface I'd read a sentence of Joel's that in its diction had struck me as an awkward hybrid of the economic and the spiritual. I could see now how characteristic that mixing is, and that perhaps the sentence isn't so awkward after all: "One of the greatest assets of a farm is the sheer ecstasy of life."