

THE  
OMNIVORE'S  
DILEMMA

A NATURAL HISTORY  
OF FOUR MEALS



MICHAEL POLLAN



PENGUIN BOOKS

INTRODUCTION

OUR NATIONAL  
EATING DISORDER

*What should we have for dinner?*

This book is a long and fairly involved answer to this seemingly simple question. Along the way, it also tries to figure out how such a simple question could ever have gotten so complicated. As a culture we seem to have arrived at a place where whatever native wisdom we may once have possessed about eating has been replaced by confusion and anxiety. Somehow this most elemental of activities—figuring out what to eat—has come to require a remarkable amount of expert help. How did we ever get to a point where we need investigative journalists to tell us where our food comes from and nutritionists to determine the dinner menu?

For me the absurdity of the situation became inescapable in the fall of 2002, when one of the most ancient and venerable staples of human life abruptly disappeared from the American dinner table. I'm talking of course about bread. Virtually overnight, Americans changed the way they eat. A collective spasm of what can only be described as carbopho-

bia seized the country, supplanting an era of national lipophobia dating to the Carter administration. That was when, in 1977, a Senate committee had issued a set of “dietary goals” warning beef-loving Americans to lay off the red meat. And so we dutifully had done, until now.

What set off the sea change? It appears to have been a perfect media storm of diet books, scientific studies, and one timely magazine article. The new diet books, many of them inspired by the formerly discredited Dr. Robert C. Atkins, brought Americans the welcome news that they could eat more meat and lose weight just so long as they laid off the bread and pasta. These high-protein, low-carb diets found support in a handful of new epidemiological studies suggesting that the nutritional orthodoxy that had held sway in America since the 1970s might be wrong. It was not, as official opinion claimed, fat that made us fat, but the carbohydrates we’d been eating precisely in order to stay slim. So conditions were ripe for a swing of the dietary pendulum when, in the summer of 2002, the *New York Times Magazine* published a cover story on the new research entitled “What if Fat Doesn’t Make You Fat?” Within months, supermarket shelves were restocked and restaurant menus rewritten to reflect the new nutritional wisdom. The blamelessness of steak restored, two of the most wholesome and uncontroversial foods known to man—bread and pasta—acquired a moral stain that promptly bankrupted dozens of bakeries and noodle firms and ruined an untold number of perfectly good meals.

So violent a change in a culture’s eating habits is surely the sign of a national eating disorder. Certainly it would never have happened in a culture in possession of deeply rooted traditions surrounding food and eating. But then, such a culture would not feel the need for its most august legislative body to ever deliberate the nation’s “dietary goals”—or, for that matter, to wage political battle every few years over the precise design of an official government graphic called the “food pyramid.” A country with a stable culture of food would not shell out millions for the quackery (or common sense) of a new diet book every January. It would not be susceptible to the pendulum-swings of food scares or fads, to the apotheosis every few years of one newly discovered nutri-

ent and the demonization of another. It would not be apt to confuse protein bars and food supplements with meals or breakfast cereals with medicines. It probably would not eat a fifth of its meals in cars or feed fully a third of its children at a fast-food outlet every day. And it surely would not be nearly so fat.

Nor would such a culture be shocked to discover that there are other countries, such as Italy and France, that decide their dinner questions on the basis of such quaint and unscientific criteria as pleasure and tradition, eat all manner of “unhealthy” foods, and, lo and behold, wind up actually healthier and happier in their eating than we are. We show our surprise at this by speaking of something called the “French paradox,” for how could a people who eat such demonstrably toxic substances as foie gras and triple crème cheese actually be slimmer and healthier than we are? Yet I wonder if it doesn’t make more sense to speak in terms of an American paradox—that is, a notably unhealthy people obsessed by the idea of eating healthily.

TO ONE DEGREE OR ANOTHER, the question of what to have for dinner assails every omnivore, and always has. When you can eat just about anything nature has to offer, deciding what you should eat will inevitably stir anxiety, especially when some of the potential foods on offer are liable to sicken or kill you. This is the omnivore’s dilemma, noted long ago by writers like Rousseau and Brillat-Savarin and first given that name thirty years ago by a University of Pennsylvania research psychologist named Paul Rozin. I’ve borrowed his phrase for the title of this book because the omnivore’s dilemma turns out to be a particularly sharp tool for understanding our present predicaments surrounding food.

In a 1976 paper called “The Selection of Foods by Rats, Humans, and Other Animals” Rozin contrasted the omnivore’s existential situation with that of the specialized eater, for whom the dinner question could not be simpler. The koala doesn’t worry about what to eat: If it looks and smells and tastes like a eucalyptus leaf, it must be dinner. The koala’s culinary preferences are hardwired in its genes. But for

omnivores like us (and the rat) a vast amount of brain space and time must be devoted to figuring out which of all the many potential dishes nature lays on are safe to eat. We rely on our prodigious powers of recognition and memory to guide us away from poisons (*Isn't that the mushroom that made me sick last week?*) and toward nutritious plants (*The red berries are the juicier, sweeter ones*). Our taste buds help too, predisposing us toward sweetness, which signals carbohydrate energy in nature, and away from bitterness, which is how many of the toxic alkaloids produced by plants taste. Our inborn sense of disgust keeps us from ingesting things that might infect us, such as rotten meat. Many anthropologists believe that the reason we evolved such big and intricate brains was precisely to help us deal with the omnivore's dilemma.

Being a generalist is of course a great boon as well as a challenge; it is what allows humans to successfully inhabit virtually every terrestrial environment on the planet. Omnivory offers the pleasures of variety, too. But the surfeit of choice brings with it a lot of stress and leads to a kind of Manichaeian view of food, a division of nature into *The Good Things to Eat*, and *The Bad*.

The rat must make this all-important distinction more or less on its own, each individual figuring out for itself—and then remembering—which things will nourish and which will poison. The human omnivore has, in addition to his senses and memory, the incalculable advantage of a culture, which stores the experience and accumulated wisdom of countless human tasters before him. I don't need to experiment with the mushroom now called, rather helpfully, the "death cap," and it is common knowledge that that first intrepid lobster eater was on to something very good. Our culture codifies the rules of wise eating in an elaborate structure of taboos, rituals, recipes, manners, and culinary traditions that keep us from having to reenact the omnivore's dilemma at every meal.

One way to think about America's national eating disorder is as the return, with an almost atavistic vengeance, of the omnivore's dilemma. The cornucopia of the American supermarket has thrown us back on a bewildering food landscape where we once again have to worry that some of

those tasty-looking morsels might kill us. (Perhaps not as quickly as a poisonous mushroom, but just as surely.) Certainly the extraordinary abundance of food in America complicates the whole problem of choice. At the same time, many of the tools with which people historically managed the omnivore's dilemma have lost their sharpness here—or simply failed. As a relatively new nation drawn from many different immigrant populations, each with its own culture of food, Americans have never had a single, strong, stable culinary tradition to guide us.

The lack of a steady culture of food leaves us especially vulnerable to the blandishments of the food scientist and the marketer, for whom the omnivore's dilemma is not so much a dilemma as an opportunity. It is very much in the interest of the food industry to exacerbate our anxieties about what to eat, the better to then assuage them with new products. Our bewilderment in the supermarket is no accident; the return of the omnivore's dilemma has deep roots in the modern food industry, roots that, I found, reach all the way back to fields of corn growing in places like Iowa.

And so we find ourselves where we do, confronting in the supermarket or at the dinner table the dilemmas of omnivorousness, some of them ancient and others never before imagined. The organic apple or the conventional? And if the organic, the local one or the imported? The wild fish or the farmed? The trans fats or the butter or the "not butter"? Shall I be a carnivore or a vegetarian? And if a vegetarian, a lacto-vegetarian or a vegan? Like the hunter-gatherer picking a novel mushroom off the forest floor and consulting his sense memory to determine its edibility, we pick up the package in the supermarket and, no longer so confident of our senses, scrutinize the label, scratching our heads over the meaning of phrases like "heart healthy," "no trans fats," "cage-free," or "range-fed." What is "natural grill flavor" or TBHQ or xanthan gum? What is all this stuff, anyway, and where in the world did it come from?

MY WAGER in writing *The Omnivore's Dilemma* was that the best way to answer the questions we face about what to eat was to go back to the very

beginning, to follow the food chains that sustain us, all the way from the earth to the plate—to a small number of actual meals. I wanted to look at the getting and eating of food at its most fundamental, which is to say, as a transaction between species in nature, eaters and eaten. (“The whole of nature,” wrote the English author William Ralph Inge, “is a conjugation of the verb to eat, in the active and passive.”) What I try to do in this book is approach the dinner question as a naturalist might, using the long lenses of ecology and anthropology, as well as the shorter, more intimate lens of personal experience.

My premise is that like every other creature on earth, humans take part in a food chain, and our place in that food chain, or web, determines to a considerable extent what kind of creature we are. The fact of our omnivorousness has done much to shape our nature, both body (we possess the omnicompetent teeth and jaws of the omnivore, equally well suited to tearing meat and grinding seeds) and soul. Our prodigious powers of observation and memory, as well as our curious and experimental stance toward the natural world, owe much to the biological fact of omnivorousness. So do the various adaptations we’ve evolved to defeat the defenses of other creatures so that we might eat them, including our skills at hunting and cooking with fire. Some philosophers have argued that the very open-endedness of human appetite is responsible for both our savagery and civility, since a creature that could conceive of eating anything (including, notably, other humans) stands in particular need of ethical rules, manners, and rituals. We are not only what we eat, but how we eat, too.

Yet we are also different from most of nature’s other eaters—markedly so. For one thing, we’ve acquired the ability to substantially modify the food chains we depend on, by means of such revolutionary technologies as cooking with fire, hunting with tools, farming, and food preservation. Cooking opened up whole new vistas of edibility by rendering various plants and animals more digestible, and overcoming many of the chemical defenses other species deploy against being eaten. Agriculture allowed us to vastly multiply the populations of a few favored food species, and therefore in turn our own. And, most recently,

industry has allowed us to reinvent the human food chain, from the synthetic fertility of the soil to the microwaveable can of soup designed to fit into a car’s cup holder. The implications of this last revolution, for our health and the health of the natural world, we are still struggling to grasp.

*The Omnivore’s Dilemma* is about the three principal food chains that sustain us today: the industrial, the organic, and the hunter-gatherer. Different as they are, all three food chains are systems for doing more or less the same thing: linking us, through what we eat, to the fertility of the earth and the energy of the sun. It might be hard to see how, but even a Twinkie does this—constitutes an engagement with the natural world. As ecology teaches, and this book tries to show, it’s all connected, even the Twinkie.

Ecology also teaches that all life on earth can be viewed as a competition among species for the solar energy captured by green plants and stored in the form of complex carbon molecules. A food chain is a system for passing those calories on to species that lack the plant’s unique ability to synthesize them from sunlight. One of the themes of this book is that the industrial revolution of the food chain, dating to the close of World War II, has actually changed the fundamental rules of this game. Industrial agriculture has supplanted a complete reliance on the sun for our calories with something new under the sun: a food chain that draws much of its energy from fossil fuels instead. (Of course, even that energy originally came from the sun, but unlike sunlight it is finite and irreplaceable.) The result of this innovation has been a vast increase in the amount of food energy available to our species; this has been a boon to humanity (allowing us to multiply our numbers), but not an unalloyed one. We’ve discovered that an abundance of food does not render the omnivore’s dilemma obsolete. To the contrary, abundance seems only to deepen it, giving us all sorts of new problems and things to worry about.

Each of this book’s three parts follows one of the principal human food chains from beginning to end: from a plant, or group of plants, photosynthesizing calories in the sun, all the way to a meal at the din-

ner end of that food chain. Reversing the chronological order, I start with the industrial food chain, since that is the one that today involves and concerns us the most. It is also by far the biggest and longest. Since monoculture is the hallmark of the industrial food chain, this section focuses on a single plant: *Zea mays*, the giant tropical grass we call corn, which has become the keystone species of the industrial food chain, and so in turn of the modern diet. This section follows a bushel of commodity corn from the field in Iowa where it grew on its long, strange journey to its ultimate destination in a fast-food meal, eaten in a moving car on a highway in Marin County, California.

The book's second part follows what I call—to distinguish it from the industrial—the pastoral food chain. This section explores some of the alternatives to industrial food and farming that have sprung up in recent years (variously called “organic,” “local,” “biological,” and “beyond organic”), food chains that might appear to be preindustrial but in surprising ways turn out in fact to be postindustrial. I set out thinking I could follow one such food chain, from a radically innovative farm in Virginia that I worked on one recent summer to an extremely local meal prepared from animals raised on its pastures. But I promptly discovered that no single farm or meal could do justice to the complex, branching story of alternative agriculture right now, and that I needed also to reckon with the food chain I call, oxymoronically, the “industrial organic.” So the book's pastoral section serves up the natural history of two very different “organic” meals: one whose ingredients came from my local Whole Foods supermarket (gathered there from as far away as Argentina), and the other tracing its origins to a single polyculture of grasses growing at Polyface Farm in Swoope, Virginia.

The last section, titled Personal, follows a kind of neo-Paleolithic food chain from the forests of Northern California to a meal I prepared (almost) exclusively from ingredients I hunted, gathered, and grew myself. Though we twenty-first-century eaters still eat a handful of hunted and gathered food (notably fish and wild mushrooms), my interest in this food chain was less practical than philosophical: I hoped to shed fresh light on the way we eat now by immersing myself in the

way we ate then. In order to make this meal I had to learn how to do some unfamiliar things, including hunting game and foraging for wild mushrooms and urban tree fruit. In doing so I was forced to confront some of the most elemental questions—and dilemmas—faced by the human omnivore: What are the moral and psychological implications of killing, preparing, and eating a wild animal? How does one distinguish between the delicious and the deadly when foraging in the woods? How do the alchemies of the kitchen transform the raw stuffs of nature into some of the great delights of human culture?

The end result of this adventure was what I came to think of as the Perfect Meal, not because it turned out so well (though in my humble opinion it did), but because this labor- and thought-intensive dinner, enjoyed in the company of fellow foragers, gave me the opportunity, so rare in modern life, to eat in full consciousness of everything involved in feeding myself: For once, I was able to pay the full karmic price of a meal.

Yet as different as these three journeys (and four meals) turned out to be, a few themes kept cropping up. One is that there exists a fundamental tension between the logic of nature and the logic of human industry, at least as it is presently organized. Our ingenuity in feeding ourselves is prodigious, but at various points our technologies come into conflict with nature's ways of doing things, as when we seek to maximize efficiency by planting crops or raising animals in vast monocultures. This is something nature never does, always and for good reasons practicing diversity instead. A great many of the health and environmental problems created by our food system owe to our attempts to oversimplify nature's complexities, at both the growing and the eating ends of our food chain. At either end of any food chain you find a biological system—a patch of soil, a human body—and the health of one is connected—literally—to the health of the other. Many of the problems of health and nutrition we face today trace back to things that happen on the farm, and behind those things stand specific government policies few of us know anything about.

I don't mean to suggest that human food chains have only recently

come into conflict with the logic of biology; early agriculture and, long before that, human hunting proved enormously destructive. Indeed, we might never have needed agriculture had earlier generations of hunters not eliminated the species they depended upon. Folly in the getting of our food is nothing new. And yet the new follies we are perpetrating in our industrial food chain today are of a different order. By replacing solar energy with fossil fuel, by raising millions of food animals in close confinement, by feeding those animals foods they never evolved to eat, and by feeding ourselves foods far more novel than we even realize, we are taking risks with our health and the health of the natural world that are unprecedented.

Another theme, or premise really, is that the way we eat represents our most profound engagement with the natural world. Daily, our eating turns nature into culture, transforming the body of the world into our bodies and minds. Agriculture has done more to reshape the natural world than anything else we humans do, both its landscapes and the composition of its flora and fauna. Our eating also constitutes a relationship with dozens of other species—plants, animals, and fungi—with which we have coevolved to the point where our fates are deeply entwined. Many of these species have evolved expressly to gratify our desires, in the intricate dance of domestication that has allowed us and them to prosper together as we could never have prospered apart. But our relationships with the wild species we eat—from the mushrooms we pick in the forest to the yeasts that leaven our bread—are no less compelling, and far more mysterious. Eating puts us in touch with all that we share with the other animals, and all that sets us apart. It defines us.

What is perhaps most troubling, and sad, about industrial eating is how thoroughly it obscures all these relationships and connections. To go from the chicken (*Gallus gallus*) to the Chicken McNugget is to leave this world in a journey of forgetting that could hardly be more costly, not only in terms of the animal's pain but in our pleasure, too. But forgetting, or not knowing in the first place, is what the industrial food chain is all about, the principal reason it is so opaque, for if we could

see what lies on the far side of the increasingly high walls of our industrial agriculture, we would surely change the way we eat.

"Eating is an agricultural act," as Wendell Berry famously said. It is also an ecological act, and a political act, too. Though much has been done to obscure this simple fact, how and what we eat determines to a great extent the use we make of the world—and what is to become of it. To eat with a fuller consciousness of all that is at stake might sound like a burden, but in practice few things in life can afford quite as much satisfaction. By comparison, the pleasures of eating industrially, which is to say eating in ignorance, are fleeting. Many people today seem perfectly content eating at the end of an industrial food chain, without a thought in the world; this book is probably not for them. There are things in it that will ruin their appetites. But in the end this is a book about the pleasures of eating, the kinds of pleasure that are only deepened by knowing.

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we cranked up the baler again. We were racing to get this hay in before thunderstorms predicted for the evening. It was Monday, my first of seven days working on the farm, and thus far my principal conclusion was that in the event I survived the labors of the week, I would never again begrudge a farmer any price he cared to name for his produce: one dollar for an egg seemed entirely reasonable; fifty dollars for a steak a steal.

The wail of farm machinery had fallen silent, and in the space it left I could hear the varied sounds of birds: songbirds in the trees, but also the low gossip of hens and the lower throat singing of turkeys. Up on the green, green shoulder of hill rising to the west I could see a small herd of cattle grazing, and, below them on a gentler slope, several dozen portable chicken pens marching in formation down the meadow.

Laid before me was, I realized, a scene of almost classical pastoral beauty—the meadows dotted with contented animals, the backdrop of woods, a twisting brook threading through it all—marred only by the fact that I couldn't just lie here on this springy pasture admiring it for the rest of the afternoon. (Wasn't leisure supposed to be a big part of the pastoral idyll?) Our culture, perhaps even our biology, disposes us to respond to just such a grassy middle landscape, suspended as it is halfway between the wilderness of forest and the artifice of civilization. "The argument of the verdurous vista," Henry James once called it. He had just returned from Europe to tour rural New England, and found himself beguiled by Connecticut's pastoral charms in spite of himself and all he knew—about history, about the inevitable triumph of the machine, about "the bullying railway." A century earlier, of course, Thomas Jefferson had made the argument of the verdurous vista with a force some of us still feel: His agrarian ideal was an attempt to make a literal American reality out of the old world's pastoral dreams, though even he sometimes doubted the middle landscape could survive the advent of industry. But then, the pastoral idyll was already in trouble even in Virgil's time, threatened by the encroaching marshlands on one side, the corruptions of civilization on the other.

The wonder really is that it survives at all. Two centuries and a one-

hour drive over the Blue Ridge from Monticello, Joel Salatin, a self-described "Christian-conservative-libertarian-environmentalist-lunatic farmer," is attempting again and against all odds to put real-live grass under the old agrarian-pastoral ideal, to try to make it new long after the triumph of the industrial system Jefferson fretted over has been completed. I'd come here to the Shenandoah Valley to see whether such a farm, and the alternative food chain it is part of, belonged to the past or the future.

Taking in Salatin's verdurous vista that afternoon, it occurred to me that the only thing missing from the scene was a happy shepherd, but then, wasn't that the tall fellow loping toward me in the broad blue suspenders and the floppy hat? Salatin's broad-brimmed straw hat did more than protect his neck and face from the Virginia sun: It declared a political and aesthetic stance, one descended from Virgil through Jefferson with a detour through the sixties counterculture. Whereas a feed company cap emblazoned with the logo of an agribusiness giant would have said labor, would have implied (in more ways than one) a debt to the industrial, Salatin's jaunty chapeau—made of grass, note, rather than plastic—bespoke independence, sufficiency, even ease. "On our farm the animals do most of the work," he had told me the first time we talked. At the moment, too tired to stand, the claim sounded to me like a pretty empty pastoral conceit. But as I would understand by the end of my week on Salatin's farm, the old pastoral idea is alive and, if not well exactly, still useful, perhaps even necessary.

## 2. THE GENIUS OF THE PLACE

Polyface Farm raises chicken, beef, turkeys, eggs, rabbits, and pigs, plus tomatoes, sweet corn, and berries on one hundred acres of pasture patchworked into another 450 acres of forest, but if you ask Joel Salatin what he does for a living (Is he foremost a cattle rancher? A chicken farmer?) he'll tell you in no uncertain terms, "I'm a grass farmer." The first time I heard this designation I didn't get it at all—hay seemed the

least (and least edible) of his many crops, and he brought none of it to market. But undergirding the "farm of many faces," as he calls it, is a single plant—or rather that whole community of plants for which the word "grass" is shorthand.

"Grass," so understood, is the foundation of the intricate food chain Salatin has assembled at Polyface, where a half-dozen different animal species are raised together in an intensive rotational dance on the theme of symbiosis. Salatin is the choreographer and the grasses are his verdurous stage; the dance has made Polyface one of the most productive and influential alternative farms in America.

Though it was only the third week of June, the pasture beneath me had already seen several rotational turns. Before being cut earlier in the week for the hay that would feed the farm's animals through the winter, it had been grazed twice by beef cattle, which after each day-long stay had been succeeded by several hundred laying hens. They'd arrived by Eggmobile, a ramshackle portable henhouse designed and built by Salatin. Why chickens? "Because that's how it works in nature," Salatin explained. "Birds follow and clean up after herbivores." And so during their turn in the pasture, the hens had performed several ecological services for the cattle as well as the grass: They'd picked the tasty grubs and fly larvae out of the cowpats, in the process spreading the manure and eliminating parasites. (This is what Joel has in mind when he says the animals do the work around here; the hens are his "sanitation crew," the reason his cattle have no need of chemical parasiticides.) And while they were at it, nibbling on the short cattle-clipped grasses they like best, the chickens applied a few thousand pounds of nitrogen to the pasture—and produced several thousand uncommonly rich and tasty eggs. After a few weeks' rest, the pasture will be grazed again, each steer turning these lush grasses into beef at the rate of two or three pounds a day.

By the end of the season Salatin's grasses will have been transformed by his animals into some 25,000 pounds of beef, 50,000 pounds of pork, 12,000 broilers, 800 turkeys, 500 rabbits, and 30,000 dozen eggs. This is an astounding cornucopia of food to draw from a hundred acres of pasture, yet what is perhaps still more astonishing is the fact

that this pasture will be in no way diminished by the process—in fact, it will be the better for it, lusher, more fertile, even springier underfoot (this thanks to the increased earthworm traffic). Salatin's audacious bet is that feeding ourselves from nature need not be a zero-sum proposition, one in which if there is more for us at the end of the season then there must be less for nature—less topsoil, less fertility, less life. He's betting, in other words, on a very different proposition, one that looks an awful lot like the proverbially unattainable free lunch.

And none of it happens without the grass. In fact, the first time I met Salatin he'd insisted that even before I met any of his animals, I get down on my belly in this very pasture to make the acquaintance of the less charismatic species his farm was nurturing that, in turn, were nurturing his farm. Taking the ant's-eye view, he ticked off the census of a single square foot of pasture: orchard grass, foxtail, a couple of different fescues, bluegrass, and timothy. Then he cataloged the legumes—red clover and white, plus lupines—and finally the forbs, broad-leaved species like plantain, dandelion, and Queen Anne's lace. And those were just the plants, the species occupying the surface along with a handful of itinerant insects; belowdecks and out of sight tunneled earthworms (knowable by their castled mounds of rich castings), woodchucks, moles and burrowing insects, all making their dim way through an unseen wilderness of bacteria, phages, eelish nematodes, shrumpy rotifers, and miles upon miles of mycelium, the underground filaments of fungi. We think of the grasses as the basis of this food chain, yet behind, or beneath, the grassland stands the soil, that inconceivably complex community of the living and the dead. Because a healthy soil digests the dead to nourish the living, Salatin calls it the earth's stomach.

But it is upon the grass, mediator of soil and sun, that the human gaze has always tended to settle, and not just our gaze, either. A great many animals, too, are drawn to grass, which partly accounts for our own deep attraction to it: We come here to eat the animals that ate the grass that we (lacking rumens) can't eat ourselves. "All flesh is grass." The Old Testament's earthy equation reflects a pastoral culture's appreciation of the food chain that sustained it, though the hunter-gatherers

living on the African savanna thousands of years earlier would have understood the flesh-grass connection just as well. It's only in our own time, after we began raising our food animals on grain in Concentrated Animal Feeding Operations (following the dubious new equation, All flesh is corn); that our ancient engagement with grass could be overlooked.

Or should I say partly overlooked, for surely our abiding affection for the stuff—reflected in our scrupulously tended lawns and playing fields, as well as in the persistence of so many forms of grassy pastoral, in everything from poetry to supermarket labels—expresses an unconscious recognition of our one-time dependence. Our inclination toward grass, which has the force of a tropism, is frequently cited as a prime example of “biophilia,” E. O. Wilson’s coinage for what he claims is our inherited genetic attraction for the plants and animals and landscapes with which we coevolved.

Certainly I was feeling the pull of the pastoral that summer afternoon on Joel Salatin’s farm; whether or not its wellsprings were in my genes who can really say, but the idea does not strike me as implausible in the least. Our species’ coevolutionary alliance with the grasses has deep roots and has probably done more to ensure our success as a species than any other, with the possible exception of our alliance with the trillion or so bacteria that inhabit the human gut. Working together, grass and man have overspread much of the earth, far more of it than would ever have been possible working alone.

This human-grass alliance has, in fact, had two distinct phases, taking us all the way from our time as hunter-gatherers to agriculturists, or, to date this natural history as the grasses might, from the Age of Perennials, like the fescues and bluegrass in these pastures, to the Age of Annuals, such as the corn George Naylor and I had planted in Iowa. In the first phase, which began when our earliest ancestors came down out of the trees to hunt animals on the savanna, the human relationship with grass was mediated by animals that (unlike us) could digest it, in much the same way it still is on Joel Salatin’s postmodern savanna. Like Salatin, hunter-gatherers deliberately promoted the welfare of the grasses in order to attract and fatten the animals they depended upon. Hunters would

periodically set fire to the savanna to keep it free of trees and nourish the soil. In a sense, they too were “grass farmers,” deliberately nurturing grasses so that they might harvest meat.

So at least it appeared to us. Regarded from the grasses’ point of view the arrangement appears even cleverer. The existential challenge facing grasses in all but the most arid regions is how to successfully compete against trees for territory and sunlight. The evolutionary strategy they hit upon was to make their leaves nourishing and tasty to animals who in turn are nourishing and tasty to us, the big-brained creature best equipped to vanquish the trees on their behalf. But for this strategy to succeed the grasses needed an anatomy that could withstand the rigors of both grazing and fire. So they developed a deep root system and a ground-hugging crown that in many cases puts out runners, allowing the grasses to recover quickly from fire and to reproduce even when grazers (or lawnmowers) prevent them from ever flowering and going to seed. (I used to think we were dominating the grass whenever we mowed the lawn, but in fact we’re playing right into its strategy for world domination, by helping it outcompete the shrubs and trees.)

The second phase of the marriage of grasses and humans is usually called the “invention of agriculture,” a self-congratulatory phrase that overlooks the role of the grasses themselves in revising the terms of the relationship. Beginning about ten thousand years ago a handful of particularly opportunistic grass species—the ancestors of wheat, rice, and corn—evolved to produce tremendous, nutritionally dense seeds that could nourish humans directly, thereby cutting out the intermediary animals. The grasses accomplished this feat by becoming annuals, throwing all their energy into making seeds rather than storing some of it underground in roots and rhizomes to get through the winter. These monster annual grasses outcompeted not only the trees, which humans obligingly cut down to expand the annuals’ habitats, but bested the perennial grasses, which in most places succumbed to the plow. Their human sponsors ripped up the great perennial-polyculture grasslands to make the earth safe for annuals, which would henceforth be grown in strict monocultures.

## 3. INDUSTRIAL ORGANIC

Hard to believe, but Joel Salatin and George Naylor are, if regarded from a great enough distance, engaged in much the same pursuit: growing grasses to feed the cattle, chickens, and pigs that feed us. Compared to Salatin, however, Naylor participates in an infinitely more complex industrial system, involving not only corn (and soybeans), but fossil fuels, petrochemicals, heavy machinery, CAFOs, and an elaborate international system of distribution to move all these elements around: the energy from the Persian Gulf, the corn to the CAFOs, the animals to slaughter, and their meat finally to a Wal-Mart or McDonald's near you. Considered as a whole this system comprises a great machine, transforming inputs of seed and fossil energy into outputs of carbohydrate and protein. And, as with any machine, this one generates streams of waste: the nitrogen and pesticides running off the cornfields; the manure pooling in the feedlot lagoons; the heat and exhaust produced by all the machines within the machine—the tractors and trucks and combines.

Polyface Farm stands about as far from this industrialized sort of agriculture as it is possible to get without leaving the planet. Joel's farm stands as a kind of alternative reality to George's: Every term governing a conventional 500-acre corn-and-bean operation in Churdan, Iowa, finds its mirror opposite here on these 550 acres in Swoope, Virginia. To wit:

## NAYLOR FARM

Industrial

Annual species

Monoculture

Fossil energy

Global market

Specialized

Mechanical

## POLYFACE FARM

Pastoral

Perennial species

Polyculture

Solar energy

Local market

Diversified

Biological

Imported fertility

Myriad inputs

Local fertility

Chicken feed

For half a century now, which is to say for as long as industrial agriculture has held sway in America, the principal alternative to its methods and general approach has gone by the name "organic," a word chosen (by J. I. Rodale, the founding editor of *Organic Gardening and Farming* magazine) to imply that nature rather than the machine should supply the proper model for agriculture. Before my journey through the organic food industry I would have thought that virtually any organic farm would belong on the Polyface side of this ledger. But it turns out that this is not necessarily the case: There are now "industrial organic" farms that belong firmly on the left-hand side. Then there is this further paradox: Polyface Farm is technically not an organic farm, though by any standard it is more "sustainable" than virtually any organic farm. Its example forces you to think a lot harder about what these words—sustainable, organic, natural—really mean.

As it happened, the reason I found my way to Polyface Farm in the first place had everything to do with Joel Salatin's unusually strict construction of the word sustainable. As part of my research into the organic food chain, I kept hearing about this organic farmer in Virginia who had no use for the federal government's new organic standards. I also kept hearing about the exceptional food he was producing. So I gave him a call, hoping to get some salty quotes about the organic industry and perhaps get him to ship me a pastured chicken or steak.

The salty quotes I got. Speaking in a rapid-fire delivery that sounded like a cross between Bill Clinton and a hopped-up TV evangelist, Salatin delivered a scathing indictment of the "organic empire." I struggled to keep up with a spirited diatribe that bounced from the "Western conquistador mentality" and the "clash of paradigms" to the "innate distinctive desires of a chicken" and the impossibility of taking a "decidedly Eastern, connected, holistic product, and selling it through a decidedly Western, disconnected, reductionist Wall Streetified marketing system."

"You know what the best kind of organic certification would be?"

trouble began when they encountered the expectations of the supermarket. As in so many other realms, nature's logic has proven no match for the logic of capitalism, one in which cheap energy has always been a given. And so, today, the organic food industry finds itself in a most unexpected, uncomfortable, and, yes, unsustainable position: floating on a sinking sea of petroleum.

TEN  
GRASS

*Thirteen Ways of Looking at a Pasture*

1. MONDAY

For something people profess to like so much, grass is peculiarly hard for us to see. Oh, you can see it well enough in a general sense, but how much do you really see when you look at a patch of grass? The color green, of course, perhaps a transitory recording of the breeze: an abstraction. Grass to us is more ground than figure, a backdrop to more legible things in the landscape—trees, animals, buildings. It's less a subject in its own right than a context. Maybe this has to do with the disparity in scale between us and the uncountable tiny beings that make up a pasture. Maybe we're just too big to see what's going on down there in any detail.

Curiously, we seem to like grass less for what it is than for what it isn't—the forest, I mean—and yet we're much more likely to identify with a tree than a blade of grass. When poets liken people to blades of grass it's usually to humble us, to pull the rug out from under our individuality and remind us of our existential puniness. Composed of so

many tiny seemingly indistinguishable parts, a patch of grass—which on closer inspection isn't even composed of grasses half the time but of legumes and broad-leafed plants of many kinds—resolves itself in our perception into an undifferentiated mass, a more or less shaggy field of color. This way of looking at, or not looking at, grass must suit us, or why would we work so hard to keep it mowed? Mowing only adds to the abstractness of grass.

This is not at all how grass looks to a cow or for that matter to a grass farmer like Joel Salatin. When one of his cows moves into a new paddock, she doesn't just see the color green; she doesn't even see grass. She sees, out of the corner of her eye, this nice tuft of white clover, the emerald-green one over there with the heart-shaped leaves, or, up ahead, that grassy spray of bluish fescue tightly cinched at ground level. These two entities are as different in her mind as vanilla ice cream is from cauliflower, two dishes you would never conflate just because they both happen to be white. The cow opens her meaty wet lips, curls her sandpaper tongue around the bunched clover like a fat rope, and with the pleasing sound of tearing foliage, rips the mouthful of tender leaves from its crown. She'll get to the fescue eventually, and the orchard grass, and even to quite a few of the weeds, but not before she's eaten all the clover ice cream she can find.

Joel calls his pastures the "salad bar," and to his cows they contain at least as many different things to eat. As well as a few things not to eat. Though we might fail to notice the handful of Carolina nightshades or thistles lurking in this pasture, when the cows are done grazing it tomorrow, those plants will still be standing, like forlorn florets of cauliflower languishing on a picky child's plate.

What watching this cow eat her supper tells me is that the scale argument doesn't really hold. The reason we don't see very much when we look at grass has less to do with our relative proportions than with our interests. The cow I'm following in Joel Salatin's pasture this evening is a far sight bigger than I am, and in most matters a good deal less perceptive, yet she can pick a clump of timothy out of this illegible green chaos in less time than it would take me to remember that plant's

name. I don't eat timothy, or even clover. But if I did I'd probably perceive the order and beauty and delectability of this salad bar as vividly as she does. Legibility, too, is in the eye of the beholder.

Joel doesn't eat grass either—it's one of the few nutritious things in nature the human omnivore, lacking a rumen to break down its cellulose, can't digest—yet he can see the salad bar almost as vividly as his cows. That first day I spent on his farm, when he insisted that before I met any animals I join him down on his belly in a pasture, he introduced me to orchard grass and fescue, to red and white clover, to millet and bluegrass, plantain and timothy and sweet grass, which he pulled a blade of for me to taste (and a very sweet grass it is). Joel wanted me to understand why he calls himself a grass farmer rather than a rancher or a pig farmer or a chicken farmer or a turkey farmer or a rabbit farmer or an egg farmer. The animals come and go, but the grasses, which directly or indirectly feed all the animals, abide, and the well-being of the farm depends more than anything else on the well-being of its grass.

Grass farming is a relatively new term in American agriculture, imported from New Zealand by Allan Nation, the editor of *Stockman Grass Farmer*, in the 1980s. *Stockman* is a tabloid monthly, chock-full of ads for portable electric fencing, mineral supplements, and bull semen, that has become the bible for the growing band of livestock producers who practice something called "management-intensive grazing," or as abbreviated in the pages of Nation's magazine, MiG. (It's sometimes also called rotational grazing.) Joel writes a column for the *Stockman Grass Farmer* called *The Pastoralist*, and has become close friends with Nation, whom he regards as something of a mentor.

When Allan Nation went to New Zealand in 1984 and heard sheep ranchers there refer to themselves as grass farmers something clicked, he says, and he began to regard the growing of food in a completely fresh light. Nation promptly changed the name of his little journal from the *Stockman* to *Stockman Grass Farmer* and "got pretty evangelical about grass." He gathered around his magazine a group of like-minded grass evangelists, including Joel, Jim Gerrish, an Idaho rancher and

teacher (who coined the phrase “management-intensive grazing”), Gerald Fry, a breeding specialist, Jo Robinson, a health writer who studies the health benefits of grass-fed meat, and an Argentine agronomist named Dr. Anibal Pordomingo. Many of these people first encountered the theory of rotational grazing in the work of André Voisin, a French agronomist whose 1959 treatise, *Grass Productivity*, documented that simply by applying the right number of ruminants at the right time pastures could produce far more grass (and, in turn, meat and milk) than anyone had ever thought possible.

Grass farmers grow animals—for meat, eggs, milk, and wool—but regard them as part of a food chain in which grass is the keystone species, the nexus between the solar energy that powers every food chain and the animals we eat. “To be even more accurate,” Joel has said, “we should call ourselves sun farmers. The grass is just the way we capture the solar energy.” One of the principles of modern grass farming is that to the greatest extent possible farmers should rely on the contemporary energy of the sun, as captured every day by photosynthesis, instead of the fossilized sun energy contained in petroleum.

For Allan Nation, who grew up on a cattle ranch in Mississippi, doing so is as much a matter of sound economics as environmental virtue. “All agriculture is at its heart a business of capturing free solar energy in a food product that can then be turned into high-value human energy,” he recently wrote in his column, *Al's Obs*; here each month he applies the theories of a decidedly eclectic group of thinkers (ranging from business gurus like Peter Drucker and Michael Porter to writers like Arthur Koestler) to the problems of farming. “There are only two efficient ways to do this,” he wrote in his column. “One is for you to walk out in your garden, pull a carrot and eat it. This is a direct transfer of solar energy to human energy. The second most efficient way is for you to send an animal out to gather this free solar food and then you eat the animal.

“All other methods of harvest and transfer require higher capital and petroleum energy inputs and these necessarily lower the return to the farmer/rancher. As Florida rancher Bud Adams once told me,

‘Ranching is a very simple business. The really hard part is keeping it simple.’”

The simplest way to capture the sun’s energy in a form food animals can use is by growing grass: “These blades are our photovoltaic panels,” Joel says. And the most efficient—if not the simplest—way to grow vast quantities of solar panels is by management-intensive grazing, a method that as its name implies relies more heavily on the farmer’s brain than on capital—or on energy-intensive inputs. All you need, in fact, is some portable electric fencing, a willingness to move your livestock onto fresh pasture every day, and the kind of intimate knowledge of grass that Joel tried to impart to me that early spring afternoon, down on our bellies in his pasture.

“The important thing to know about any grass is that its growth follows a sigmoid, or S, curve,” Joel explained. He grabbed my pen and notebook and began drawing a graph, based on one that appears in Voisin’s book. “This vertical axis here is the height of our grass plant, okay? And the horizontal axis is time: the number of days since this paddock was last grazed.” He started tracing a big S on the page, beginning in the lower left-hand corner where the two axes met. “See, the growth starts out real slow like this, but then after a few days it begins to zoom. That’s called ‘the blaze of growth,’ when the grass has recovered from the first bite, rebuilt its reserves and root mass, and really taken off. But after a while”—the curve leveled out at around day fourteen or so—“it slows down again, as the grass gets ready to flower and seed. It’s entering its period of senescence, when the grass begins to lignify [get woody] and becomes less palatable to the cow.

“What you want to do is graze a pasture right at this point here”—he tapped my pad sharply—“at the very top of the blaze of growth. But what you never, ever want to do is violate the law of the second bite. You can’t let your cows take a second bite of a grass before it has had a chance to fully recover.”

If the law of the second bite were actually on the books, most of the world’s ranchers and dairy farmers would be outlaws, since they allow their stock to graze their pastures continuously. By allowing cattle a sec-

ond or third bite, the most desirable "ice cream" species—clover, orchard grass, sweet grass, bluegrass, timothy—weaken and gradually disappear from the sward, giving way to bald spots and to weedy and brushy species the cows won't touch. Any plant wants to keep its roots and shoots roughly in balance, so grasses kept short by overgrazing lack the deep roots needed to bring water and minerals up from the subsoil. Over time a closely cropped grassland deteriorates, and in a dry or brittle environment, it will eventually turn into a desert. The reason environmentalists in the western United States take such a dim view of grazing is that most ranchers practice continuous grazing, degrading the land by flouting the law of the second bite.

Joel pulled a single blade of orchard grass, showing me exactly where a cow had sheared it the week before, and pointing out the finger of fresh green growth that had emerged from the cut in the days since. The blade was a kind of timeline, sharply demarcated between the dark growth predating the bite, and the bright green blade coming after it. "That's the blaze of growth, right there. I'd say this paddock will be ready for the cows to come back in three or four more days."

"Management intensive" it is. Joel is constantly updating the spreadsheet he keeps in his head to track the precise stage of growth of the farm's several dozen paddocks, which range in size from one to five acres, depending on the season and the weather. This particular paddock, a flattish five acres directly behind the barn that is bordered to the north by a hedgerow and to the south by the creek and dirt road that links Polyface's various parts and pastures like a crooked tree trunk, now took its place on the mental schedule. The sheer number of local variables involved in making such a determination hurt my head to consider, and help explain the difficulty of fitting intensive grazing into an industrial agriculture founded on standardization and simplicity. The amount of time it takes a paddock to recover is constantly changing, depending on temperature, rainfall, exposure to the sun, and the time of year, as does the amount of forage any given cow requires, depending on its size, age, and stage of life: A lactating cow, for example, eats twice as much grass as a dry one.

The unit in which a grass farmer performs and records all these calculations, deciding exactly when and where to move the herd, is a "cow day," which is simply the average amount of forage a cow will eat in one day; for his rotations to work, the farmer needs to know just how many cow days each paddock will yield. Though it turns out that, as a unit of measurement a cow day is a good deal more rubbery than, say, the speed of light, since the number of cow days any given paddock can supply rises and falls in response to all the aforementioned variables.

As destructive as overgrazing can be to a pasture, undergrazing can be almost as damaging, since it leads to woody, senescent grasses and a loss of productivity. But getting it just right—grazing the optimal number of cattle at the optimal moment to exploit the blaze of growth—yields tremendous amounts of grass, all the while improving the quality of the land. Joel calls this optimal grazing rhythm "pulsing the pastures" and says that at Polyface it has boosted the number of cow days to as much as four hundred per acre; the county average is seventy. "In effect we've bought a whole new farm for the price of some portable fencing and a lot of management."

Grass farming done well depends almost entirely on a wealth of nuanced local knowledge at a time when most of the rest of agriculture has come to rely on precisely the opposite: on the off-farm brain, and the one-size-fits-all universal intelligence represented by agrochemicals and machines. Very much on his own in a very particular place, the grass farmer must continually juggle the various elements of his farm in space as well as time, relying on his powers of observation and organization to arrange the appointed daily meeting of animal and grass in such a way as to ensure maximum benefit for both.

So is this sort of low-tech pastoralism simply a throwback to preindustrial agriculture? Salatin adamantly begged to differ: "It might not look that way, but this is all information-age stuff we're doing here. Polyface Farm is a postindustrial enterprise. You'll see."



## 2. MONDAY EVENING

As I neared the blessed, longed-for end of my first day as a Polyface farmhand, I must say I didn't feel at all the way I normally do after a day spent laboring in the information economy. And there was still one more daunting chore before dinner: moving the cows, an operation that, Joel wanted me to understand, is a whole lot easier than it sounds. I certainly hoped so. Throwing and stacking fifty-pound bales of hay all afternoon had left me bone tired, sore, and itchy all over from pricks of the chaff, so I was mightily relieved when Joel proposed we ride the four-wheeler to the upper pasture where the cows had spent their day. (It's axiomatic that the more weary you feel the more kindly you look on fossil fuel.) We stopped by the toolshed for a freshly charged car battery to power the electrified paddock fence, and sped up the rutted dirt road, Joel behind the wheel, me hanging on behind him, trying to keep my rear end planted on the little wooden deck he'd rigged up for hauling stuff around the farm.

"My neighbors think I'm insane, moving my cows as often as I do. That's because when most people hear the words 'moving the cattle' they picture a long miserable day, featuring a couple of pickup trucks, a bunch of barking dogs, several cans of Skoal, and a whole lot of hollering," Joel said, hollering himself to be heard over the ATV's engine. "But honestly, it's not like that at all."

Like most grass farmers who practice rotational grazing, Joel moves his cattle onto fresh grass every day. The basic principle is "mob and move," he explained, as we bumped to a halt at the gate to the upper pasture. Eighty or so cattle were milling or lying around what looked like relatively tight quarters in a fenced-off section of a much larger pasture that sloped to the south.

"What we're trying to do here is mimic on a domestic scale what herbivore populations do all over the world. Whether it is wildebeests on the Serengeti, caribou in Alaska, or bison on the American plains,

multistomached herds are always moving onto fresh ground, following the cycles of the grass. Predators forced the buffalo to move frequently, and stay mobbed-up together for safety."

These intense but brief stays completely change the animals' interaction with the grass and the soil. They eat down just about everything in the paddock, and then they move on, giving the grasses a chance to recover. Native grasses evolved to thrive under precisely such grazing patterns; indeed, they depend on them for their reproductive success. Not only do ruminants spread and fertilize seed with their manure, but their hoofprints create shady little pockets of exposed soil where water collects—ideal conditions for germinating a grass seed. And in brittle lands during the driest summer months, when microbial life in the soil all but stops, the rumen of the animals takes over the soil's nutrient-cycling role, breaking down dry plant matter into basic nutrients and organic matter, which the animals then spread in their urine and manure.

The mob-and-move routine also helps to keep the ruminants healthy. "Short-duration stays allow the animals to follow their instinct to seek fresh ground that hasn't been fouled by their own droppings, which are incubators for parasites."

Joel disconnected the electric fence from its battery and held down the wire with his boot to let me into the paddock. "We achieve the same objective domestically with our portable electric fences. The fence plays the role of predator in our system, keeping the animals mobbed up and making it possible for us to move them every day." The technology for this light, inexpensive electric fencing (elements of which Joel's father invented in the 1960s) was the breakthrough that made management-intensive grazing practical. (Though much earlier, dogs allowed shepherds to practice a rough approximation of rotational grazing.)

Clearly Joel's cattle knew the drill; I could feel their anticipation. Cows that had been lying around roused themselves, and the bolder ones slowly lumbered over in our direction, one of them—"That's Budger"—stepping right up to nuzzle us like a big cat. Joel's herd is an exceptionally amiable if somewhat motley crew of black, brown, and

yellowish animals, crosses of Brahman, Angus, and shorthorn bloodlines. He doesn't believe in artificial insemination or put much stock in fancy genetics. Instead he picks a new bull from his crop of calves every couple of years, naming him for a celebrated Lothario: Slick Willie had the job for much of the Clinton administration. You wouldn't mistake Slick's progeny for show cattle, yet their coats were sleek, their tails were clean, and for cows on a steamy afternoon in June, they had remarkably few flies on them.

It took the two of us working together no more than fifteen minutes to fence a new paddock next to the old one, drag the watering tub into it, and set up the water line. (The farm's irrigation system is gravity-fed from a series of ponds Joel's dug on the hillside.) The grasses in the new paddock were thigh-high and lush, and the cattle plainly couldn't wait to get at them.

The moment arrived. Looking more like a *maître d'* than a rancher, Joel opened the gate between the two paddocks, removed his straw hat and swept it grandly in the direction of the fresh salad bar, and called his cows to their dinner. After a moment of bovine hesitation, the cows began to move, first singly, then two by two, and then all eighty of them sauntered into the new pasture, brushing past us as they looked about intently for their favorite grasses. The animals fanned out in the new paddock and lowered their great heads, and the evening air filled with the muffled sounds of smacking lips, tearing grass, and the low snuffling of contented cows.

The last time I had stood watching a herd of cattle eat their supper I was standing up to my ankles in cow manure in Poky Feeders pen number 43 in Garden City, Kansas. The difference between these two bovine dining scenes could not have been starker. The single most obvious difference was that these cows were harvesting their own feed instead of waiting for a dump truck to deliver a total mixed ration of corn that had been grown hundreds of miles away and then blended by animal nutritionists with urea, antibiotics, minerals, and the fat of other cattle in a feedlot laboratory. Here we'd brought the cattle to the food rather than the other way around, and at the end of their meal there'd

be nothing left for us to clean up, since the cattle would spread their waste exactly where it would do the most good.

Cows eating grasses that had themselves eaten the sun: The food chain at work in this pasture could not be any shorter or simpler. Especially when I compared it to the food chain passing through the feedlot, with its transcontinental tentacles reaching all the way back to cornfields in Iowa, from there to the hypoxic zone in the Gulf of Mexico, and farther still, to the oil fields of the Persian Gulf that had supplied much of the energy to grow the corn. The flaked number 2 corn in steer 534's feed bunk linked him to an industrial (not to mention military) complex that reached halfway around the world.

And yet if I could actually see everything that was going on right here in this pasture, could trace all the ecological connections involved, the scene unfolding directly before me was not nearly as simple as it looked. In fact, there was easily as much complexity present in a single square foot of this pasture as there is in the whole industrial complex into which 534 was plugged; what makes this pasture's complexity so much harder for us to comprehend is that it is not a complexity of our making.

But try anyway. Focus in for a moment on just the relationship between Budger and the tuft of fescue she's tearing from its crown. Those blades of grass have spent this long June day turning sunlight into sugars. (The reason Joel moves his cattle at the end of the day is because that's when sugar levels in the grass hit their peak; overnight the plant will gradually use up these reserves.) To feed the photosynthetic process the grass's roots have drawn water and minerals up from deep in the soil (some grasses can sink their roots as much as six feet down), minerals that soon will become part of this cow. Chances are Budger has also chosen exactly which grasses to eat first, depending on whatever minerals her body craves that day; some species supply her more magnesium, others more potassium. (If she's feeling ill she might go for the plantain, a forb whose leaves contain antibiotic compounds; grazing cattle instinctively use the diversity of the salad bar to medicate themselves.) By contrast 534, who never got to pick and choose his dinner,

let alone his medications, depends on animal nutritionists to design his total ration—which of course is only as total as the current state of knowledge in animal science permits.

So far the relationship between Budger and this square foot of pasture might seem a little one-sided, since viewed at least from where I stood, Budger's bite appears to have diminished the pasture. But if I could view the same event from underground and over time, I would see that that bite is not a zero-sum transaction between cow and grass plant. The moment Budger shears the clump of grass, she sets into motion a sequence of events that will confer a measurable benefit on this square foot of pasture. The shorn grass plant, endeavoring to restore the rough balance between its roots and leaves, will proceed to shed as much root mass as it's just lost in leaf mass. When the discarded roots die, the soil's resident population of bacteria, fungi, and earthworms will get to work breaking them down into rich brown humus. What had been the grass plant's root runs will become channels through which worms, air, and rainwater will move through the earth, stimulating the process by which new topsoil is formed.

It is in this manner that the grazing of ruminants, when managed properly, actually builds new soil from the bottom up. Organic matter in a pasture also builds from the top down, as leaf litter and animal wastes break down on the surface, much as it does on a forest floor. But in a grassland decaying roots are the biggest source of new organic matter, and in the absence of grazers the soil-building process would be nowhere near as swift or productive.

Back up to the surface now. Over the next few days, Budger's shearing of this grass plant will stimulate new growth, as the crown redirects reserves of carbohydrate energy from the roots upward to form new shoots. This is the critical moment when a second bite would derail the grass's recovery, since the plant has to live on these reserves until it has grown new leaves and resumed photosynthesis. As the plant adds leaves it adds new roots too, reaching deeper into the soil, making good use of the humus the first bite helped sponsor, and bringing nutrients up to the surface. Over the course of the season this one grass plant will con-

vert more sunlight into more biomass, both above and below the surface of the pasture, than it ever would have had it never encountered a cow.

Yet it's misleading to speak about any grass plant in isolation, since many different plant species, performing many different functions, occupy even this one square foot of pasture, and Budger's bite subtly alters the composition of this community. The shearing of the tallest grasses exposes the pasture's shorter plants to sunlight, stimulating their growth. This is why a well-grazed pasture will see its population of ground-hugging clovers increase, a boon to grasses and grazers alike. These legumes fix nitrogen in the soil, fertilizing the neighboring grasses from below while supplying nitrogen to the grazers above; the bacteria living in the animal's rumen will use the nitrogen in these clover leaves to construct new molecules of protein.

Side-by-side comparisons of intensive and continuously grazed pastures have demonstrated that intensive grazing increases the diversity of species in pastures. That's because rotated cattle don't eliminate favored species by overgrazing them and their equal-opportunity shearing ensures that no one species of grass ever dominates by rising to hog all the sunlight. This biodiversity confers a great many benefits on all parties. At the most fundamental level, it allows the farm's land to capture the maximum amount of solar energy, since one kind of photosynthesizer or another is occupying every conceivable niche—niches in space as well as time. For example, when the early season grasses slow down in June, the late season grasses step in, and when drought hits, the deep-rooted species will take over from the shallower ones. A diverse enough polyculture of grasses can withstand virtually any shock and in some places will produce in a year nearly as much total biomass as a forest receiving the same amount of rainfall.

This productivity means Joel's pastures will, like his woodlots, remove thousands of pounds of carbon from the atmosphere each year; instead of sequestering all that carbon in trees, however, grasslands store most of it underground, in the form of soil humus. In fact, grassing over that portion of the world's cropland now being used to grow

grain to feed ruminants would offset fossil fuel emissions appreciably. For example, if the sixteen million acres now being used to grow corn to feed cows in the United States became well-managed pasture, that would remove fourteen billion pounds of carbon from the atmosphere each year, the equivalent of taking four million cars off the road. We seldom focus on farming's role in global warming, but as much as a third of all the greenhouse gases that human activity has added to the atmosphere can be attributed to the saw and the plow.

The benefits of a food chain rooted in a perennial polyculture are so many and so great that they've inspired dreams of converting our agriculture of annual grains into something that would look a lot more like Joel Salatin's pastures. That particular vision hatched more than thirty years ago in the mind of a graduate student in plant genetics named Wes Jackson. Today breeders at his Land Institute, in Salina, Kansas, are working on a (very) long-term project to "perennialize" many of our principal grain crops (including corn) and then grow them in polycultures that farmers would seldom if ever have to plow or replant. The basic idea is to allow us to live off the land (and the sun) more like ruminants do, by coaxing perennial grasses (which we can't digest) to yield bigger and more nutritious seeds (which we can). Of course, the same goal would be accomplished by changing us rather than the grasses—giving people rumens, that is, so they could digest grasses. And there are skeptics who believe perennializing the major crops is no less of a pipe dream than outfitting humans with rumens. Jackson claims his group is making slow but steady progress, however, and has already disproved the conventional wisdom, widely held among botanists, that plants must choose, in effect, between devoting their energy to the production of seeds, as annuals do, or using it to survive the winter in the manner of perennials.

For the time being, though, I'll have to eat Budger herself if I want to make use of the food energy contained in the grasses growing in Joel Salatin's pastures. For me, Wes Jackson's audacious vision of an agriculture that might someday feed us without diminishing the earth's sub-

stance (its soil), as even the most sustainable annual agriculture must do, only deepens my appreciation for the grass-based food chain we already have—the one, I mean, that links Budger to the soil and sun and, eventually, to me. It's true that prodigious amounts of food energy are wasted every time an animal eats another animal—nine calories for every one we consume. But if all that energy has been drawn from the boundless storehouse of the sun, as in the case of eating meat off this pasture, that meal comes as close to a free lunch as we can hope to get. Instead of mining the soil, such a meal builds more of it. Instead of diminishing the world, it has added to it.

ALL OF WHICH begs a rather large question: Why did we ever turn away from this free lunch in favor of a biologically ruinous meal based on corn? Why in the world did Americans ever take ruminants off the grass? And how could it come to pass that a fast-food burger produced from corn and fossil fuel actually costs less than a burger produced from grass and sunlight?

I asked myself these questions standing there in Joel's pasture that evening, and in the months since I've thought of several answers. The most obvious answer turns out not to be true. I had thought that the victory of corn over grass might owe to the fact that a field of corn simply produces more total food energy than an acre of grass; it certainly looks that way. But researchers at the Land Institute have studied this question and calculated that in fact more nutrients are produced—protein and carbohydrate—in an acre of well-managed pasture than in an acre of field corn. How can this be? Because a polyculture of grass, with its wide diversity of photosynthesizers exploiting every inch of land as well as every moment of growing season, captures more solar energy and therefore produces more biomass than a cornfield; also, only the kernels are harvested from a cornfield, whereas virtually all the grass grown in a pasture finds its way into the rumen.

Even so, the temptations of cheap corn are powerful, as irresistible