DOREEN B. TOWNSEND CENTER OCCASIONAL PAPERS • 27

THE BOTANY OF DESIRE • TOWNSEND CENTER OCCASIONAL PAPERS • 27

CANNABIS, FORGETTING, AND THE BOTANY OF DESIRE

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The Botany of Desire

THE DOREEN B. TOWNSEND CENTER FOR THE HUMANITIES was established at the University of California at Berkeley in 1987 in order to promote interdisciplinary studies in the humanities. Endowed by Doreen B. Townsend, the Center awards fellowships to advanced graduate students and untenured faculty on the Berkeley campus, and supports interdisciplinary working groups, lectures, and team-taught graduate seminars. It also sponsors symposia and conferences which strengthen research and teaching in the humanities, arts, and related social science fields. The Center is directed by Candace Slater, Professor of Spanish and Portuguese. Christina M. Gillis is the Associate Director.

CANNABIS, FORGETTING, AND THE BOTANY OF DESIRE includes the proceedings of several important events scheduled by the Townsend Center in celebration of Michael Pollan's residency as Avenali Lecturer for the 2002 Fall Semester. In this Occasional Paper we present transcripts of the public lecture Pollan gave as well as the comments of a panel organized to explore the environmental impact of food production in general. Both sections are followed by audience commentary. The Avenali Lectures are made possible by an endowment established by Peter and Joan Avenali.

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Preface

I first met Michael Pollan about seven years ago, on a less than auspicious occasion. It was a conference that had been put together by the environmental historian, Bill Cronon, for both academics and non-academics. We were going to talk about the direction of American environmentalism. This was a pretty good idea in that it had just been the time that Newt Gingrich was in power and was viably discussing the Contract with America. The conference had a few little problems, though, and probably the biggest one was actually the title. It was called 'Beyond Environmentalism.' This was like bringing together a room full of very devout Catholics, Buddhists, and Muslims to discuss something called 'Beyond Religion.' The tension was a bit palpable. And what I remember very definitely from the conference, among other things, was Michael Pollan, sitting there with a calm—I might even say a strategic obviousness—that one can only envy. I also remember Michael asking extremely thoughtful questions, and I remember above all his curiosity when people answered. He was maybe the only one of the whole group who managed to convince both sides that he was a member of their team. That's enviable.

I would say that the ability to move between the academic and the non-academic, to proceed through questions, and to display an infectious sense of curiosity are present throughout just about everything that Michael Pollan has authored. So is the ability to shift easily between the terms nature and environment to, sometimes, extremely fixed categories, and to underscore the presence of weighty environmental problems in the various practices of everyday life through gardening, eating, or a chance encounter with a bee, a dog, and here in Berkeley, a raccoon.

Unlike any of the previous lecturers in our Distinguished Series funded by Joan and Peter Avenali, Michael Pollan is about to become a Berkeley professor. He has accepted an appointment, happily for us, beginning in Fall 2003. Before, however, he takes on his duties as a member of the School of Journalism, we at the Townsend Center want to welcome him also into the humanities, and the various allied fields that the Center serves. We see in him a remarkable power to discern the intertwining ecological, political, and moral valences of problems that are at once contemporary and deeply rooted in Western history and culture. We also see in his books and articles important questions about writing: to whom are we as committed researchers trying to speak, and how can we be both deeply serious about ideas and courses, and yet clear, and even engaging, at the same time? These are not easy questions. We hope that Michael will become a regular presence among us, moving as easily among schools and disciplines as he did amongst the academics and non-academics.

Because he's been on campus before, many of you already know Michael Pollan. You know that he studied in Oxford and at Bennington College, and that he took an MA in English at Columbia University. You also know that he interned at *Village Voice* and then went on to work for eleven years as Executive Editor at *Harper's Magazine*, during which time the magazine garnered six national magazine awards. You doubtless also know that he's been a contributing editor since 1995 to *Harper's*. And any of you who read his recent *New York Times Magazine* article on animal rights know very well that he contributes to that publication. He has also published numerous books, including *A Gardener's Education, A Place of My Own, The Education of an Amateur Builder*, and most recently, *The Botany of Desire: A Plant's Eye View of the World*. The latter, of course, is on the *New York Times* Bestseller List, and is being translated into at least a half dozen different languages.

—Candace Slater
Director, Townsend Center for the Humanities
Marian E. Koshland Distinguished Professor in the Humanities

Cannabis, Forgetting, and the Botany of Desire

Michael Pollan

I want to get a couple things about myself out of the way before I start. The first one is that, as you know, I write about plants. Whenever I take questions from an audience, which I hope to do when I finish speaking, there's always someone who says, "Is that your real name?" I mean, it does seem awfully convenient, I realize that. But I've also learned from people asking these questions that it is a certain genre of name called the "career natural," or an even better term is the "aptonym." So I guess I have a good aptonym. I've been collecting others. The last time I was in the Bay Area I was told about a podiatrist named Dr. Toesy, which I kind of like. There are always doctors with these great names. I collected Drs. Slaughter, Smother, and Kaufman. There are lots of great urologists. There's a Dr. Klap in Buffalo, and Dr. Peckler somewhere else. And, of course, the head of the Audubon Society is John Flicker. Over Friends of Animals, Priscilla Ferrell presides. But one of my favorites is a woman named Angela Ovary, who wrote a wonderful gardening book called *Sex in Your Garden*.

So we're going to talk a little bit about sex in your garden, and drugs, and rock and roll. I want to start by briefly explaining what I mean by the botany of desire, about my approach to plants and their relationship to people, and then get on to marijuana. Those who have the book, *Botany of Desire*, will recognize some of what I'm saying, at least at the start. But I then want to go a little bit deeper into what we've learned and what we're learning about cannabis and the cannabinoid network and memory since the book has come out. We're learning things actually almost every day about this very exciting area of brain science. But fitting

this Avenali Lecture, and the setting, actually, I come to this scientific topic from very much a humanities point of view. I'm told now I'm a science journalist, which came as something of a surprise to me. I didn't know I was writing science. I felt a little like the character in Molière who didn't know he was speaking prose, but apparently that is what I write.

We have a bad habit in the humanities of assuming that scientists have the last word. But when I was doing the research for my chapter on cannabis in the book, I remember asking a pharmacologist in New York, who had studied drugs for years and years, "Well, what does it mean scientifically to be high?" He said something very interesting: "Well, you know, we don't understand consciousness yet scientifically, so how can we hope to understand changes in consciousness scientifically?" He and others basically told me that, for now, you're better off with the poets on this one. This is one area where the philosophers and the poets may yet have much to teach the scientists.

I also chose this topic for tonight, though, because here in California we're in one of the most important theaters in the battle over marijuana—medical marijuana—which is the battle to relegitimize this powerful plant. But I want to get past the drug war and the political perspective tonight. I'm not going to talk that much about it, although we could address it in the question period if you like. Rather, if we can, I want to look at the plant and other plant drugs as Darwinians, rather than as drug warriors.

The last reason I chose this topic is that I think I'm in a room full of people who are very well equipped—better than I, I think—to pursue at length some of the paths I'm hoping to point towards with regard to our understanding of consciousness and drugs.

But let me start with the plants. They possess an astounding and really overlooked power to nourish us and poison us, to delight our senses of sight and smell and taste, to calm our nerves or wake us up, even to change the contents of our minds and experience of consciousness. This to me is just an amazing fact, and it's an everyday fact that we don't really deal with. That's really what I undertook to deal with in the book. The first question is: why should plants have these powers? Those of you who have read the book know that the beginning of my answer—or my attempt to find an answer—as in so much of my writing, began in my garden. I really began as a gardener/writer, in many ways. One of the things I

love about gardening is that it is very desultory kind of work; it doesn't occupy all of your brain, by any means, at least the way I do it, and so there's plenty of room for speculation and for posing to oneself silly questions while one labors. It's not the same with carpentry, about which I've also written (I wrote a book on architecture and building). If you let your mind wander while you do carpentry, you end up wounded. But in the garden this isn't likely to happen. One day, during the first week of May, I was planting potatoes, and right next to me was a flowering apple tree. It was that week in May, in Connecticut where I live, where the apples were just in spectacular blossom, and the bees were going crazy, and this tree was just vibrating with the attention of the bumble bees. So I asked myself this sort of silly, but ultimately to me quite profound question: what did I have in common with those bumble bees as workers in this garden? Now, I wasn't thinking about Marx, and many people on this campus have reminded me that Marx has a whole riff on bumble bees. This wasn't on my mind, so don't read that into what I'm saying.

I realized that the bumble bee and I had a lot in common. We were both going about getting what we wanted from nature, but at the same time we were unwittingly disseminating the gene of one species and not another. The bee, like me, to the extent he thinks about this at all, thinks he's calling the shots. (Actually, it's she. In the case of bumble bees, apparently it's female bees that do the work.) The bee has chosen to go to that particular flower, breaks in, grabs the nectar, runs off, gets away with the goods. But we know that this sense of control the bee feels, assuming she feels it, is simply a failure of bee imagination. What is really happening is that the plant has cleverly manipulated that bee into paying it a visit. And in the case of the bee, the plant does this by evolving precisely the right combination and kinds of molecules—the right color, the right shape, the right attitude toward the sun—to gratify the bee's desires. We know this from elementary or college botany. This is co-evolution, two species coming together to advance their own self-interest. They wind up trading favors, often without knowing it.

So how are matters any different between me and the potatoes I was planting, or me and the marijuana plant I wasn't planting in my garden? The plants, too, in those cases, have evolved to gratify our desires. That potato has developed precisely the flavors, the shapes, the colors, to earn a spot in our

garden. In this case, I was seduced by the pages of a seed catalog, and I ordered these potatoes from a firm in Oregon, and the genes were flown across the country, or shipped across the country, and that potato seized a little bit of habitat, a couple of rows in my garden.

Plants, too, evolve to gratify our desires—a certain select group of angiosperms, the domesticated plants—which we happen to reproduce. We give them more habitat, and we carry their genes all around the world. This is what I mean by the botany of desire. Our desire, and the desire we're going to talk about tonight—specifically the desire for intoxication, for changes in consciousness—possesses a powerful force in natural history, in evolution, in much the same way that the hummingbird's desire and love of red is a case of co-evolution.

Now for the first of two disclaimers: this process is not intentional. When I talk about these plants cleverly manipulating us, I'm obviously using figurative language. We don't have a very good vocabulary for talking about how other species act on us, about their agency. We see the world as if we're the thinking subject, and then you've got that subject's object. And so, you know, I pull the weeds, I plant the potatoes, I harvest the crops. But this is just a limitation of our language. Even real evolutionary biologists talk about things like evolutionary strategy. And the word "strategy" has intent in it, but, of course, we know that's not how evolution works. The first red apple was not the result of a bunch of green apples sitting around a table saying, "Let's try red today. We'll do a red apple, we'll see if we get noticed, and we'll see if we get…" It was a mutation, strictly an accident. So even though I'm going to use this language of intention, I don't think plants are conscious. I'm not the Oliver Stone of the plant world. There's no conspiracy here.

Now, why do plants need to go to all this trouble? The THC molecule, one of the active ingredients in marijuana, is a very complicated molecule, and it takes some expense, metabolic expense, for the plant to produce it. These colors, these scents, all these are expensive propositions. Well, the main reason plants need to do all this, to gratify our desires, is that they can't move. The single great existential fact of plant life is… well, they can't locomote. They can move with the wind and water, but they can't pick themselves up and go. So what they've worked on, what they have, are chemicals instead of legs. Cannabis works on our minds in order to borrow our feet, basically. And plants have developed this incredible

variety of molecules—and, again, we're only going to concentrate on one or two today—either to attract or repel other species. They have to rely on chemistry for their defense and for their propagation: for their movement. And they've gotten really, really good at this.

You know, they're so unlike us. We really fail to appreciate their genius. And although I won't speak in terms of plant consciousness, I will speak in terms of genius. I think you can make a case that they are as advanced as we are. You look a little skeptical. But when you think about it, what does that mean, to be an advanced creature, an advanced being? It all depends on what advances you value, and who is drawing up the yardstick. You know, we value consciousness, and tool-making, and the ability to write books, and give lectures. But by the yardstick of organic chemistry, they are so far beyond us. They've been evolving even longer than we have, just in another direction, working on other ways to confront the same challenges of life on earth, especially the challenges of reproduction and defense.

Now, you still look skeptical. Another measure we could look at—I'm trying to be objective about this—just has recently come out, and that is, the size of the human genome. I don't know if you followed this, but I think the most interesting thing to come out of the much ballyhooed mapping of the genome was the number of genes we apparently have. The first estimate is—and this came as something of a surprise—only about 35,000. This is actually kind of scandalous, if you consider that the roundworm, a creature that can't do all sorts of things, has something like 20,000 genes. How is it that we ended up with so many fewer genes than were predicted? They predicted over 100,000, I believe. Another species we've mapped at the same time is rice. You know how many genes rice has, first count? 50,000. 15,000 more genes that we have. Why should this be? I don't know that that's a fair standard for being more advanced, but it is one snapshot on complexity. The reason for its complexity probably has to do with the fact that everything rice does depends on producing interesting molecules—proteins—and you need genes to do that. So perhaps that's why.

So I have enormous respect for the sophistication of these plants. We shouldn't sell them short. While we were nailing down consciousness and locomotion, they were perfecting organic chemistry, and they've achieved, you know, the arts of molecular seduction and defense; they are nature's alchemists, indeed.

There are lots of examples. I'll just give you one: Photosynthesis is, of course, one of the great examples. This is an astonishing trick, to be able to take sunlight and water—very common elements—and create sugars, food, energy. We can do nothing like this. But the other example I've come across recently is the lima bean. I like this one, as a gardener. Do you know what a lima bean does when it's attacked by spider mites? It releases a volatile chemical from its leaves. The chemical goes off in the air and summons another insect that dines exclusively on spider mites. So the lima bean sends out this chemical SOS, insects come to its rescue, they eat all the spider mites, and everybody's happy. You know, our idea of a pesticide, by comparison, is just so crude it's not even funny. So when people ask me things like, "Do you think your plants are conscious?" I say, "Isn't it enough that they can eat sunlight and do these things?" I'm a believer in plant genius.

Let's get to the case of drug plants. One of the most important relationships we have with plants involves, as I've said, changing consciousness. Now, when I talk about changing consciousness, I'm not just talking about illicit drugs. I'm also talking about things like coffee and nicotine and tea, anything that changes the texture of consciousness. We're not talking about hallucinogens, although we'll talk a little bit about them.

Apparently, all cultures except the Inuit have used plants to change consciousness, and the Inuit are truly the exception that proved the rule. The reason the Inuit never did it is that nothing very psychoactive grows where they live. As soon as plants with these powers were introduced, they took to them pretty quickly.

Andrew Weil calls this desire for changing consciousness the fourth human drive, after food, water, and sex. I think he is right. It certainly is a very widespread activity—a lot more widespread than we realize—and it doesn't always involve drugs. In his first book, *The Natural Mind*, which is still well worth reading, Weil points out that kids love to change consciousness, and they do it by swinging, and by getting dizzy. We do it with exercise and meditation and fasting and thrill-seeking. We're creatures, apparently, who just happen to like to fiddle with our brain chemistry.

Most cultures, curiously, promote one plant for this purpose, or two, and condemn others. They fetishize one and they have taboos on others. And if you look at things historically or geographically, cross-culturally, you will see that it's

very relative and subject to change. In my garden, I have apples trees that were planted in the teens. Back in the 20's, during prohibition, those apple trees were regarded the way marijuana plants are today. They were the root of all evil, producing alcohol. And they were chopped down in many places by Carrie Nation. That's what her hatchet symbolized: something to chop down apple trees because they were used for cider. At the same time, you could go into any pharmacy in America and buy preparations containing cannabis, tinctures of cannabis, and as well as tinctures of opium. And, of course, between the Muslim world and the West, you have a flip between opiates and alcohol. This plant is a panacea and this one is a panapathogen, a root of all evil. It's a constant in human societies.

Now, what's the use of these drug plants in evolutionary terms? Well, one of the more interesting theories that was proposed by Steven Pinker, the brain scientist, is that our attraction to plant drugs is the coming together of two distinct adaptive traits. We have a system of brain rewards, such that anytime we do something very heroic or useful, our brain is flooded with chemicals that make us feel good, and that's very adaptive. We also have this big brain designed for solving problems. So you bring the second trait to bear on the first, and you figure out a way to trick the brain into triggering its reward system. It's a pretty good theory.

We're not the only species who do this, though. You know, animals also get high, like to be intoxicated. Everyone is familiar with the example of catnip and loco weed. And, in fact, it appears that animals were our Virgils in the garden of psychoactive plants. We learned about a lot of these plants from watching animals get high. Coffee was discovered, apparently, by Abyssinian goat herders watching their goats. What their goats would do is eat the red berries off this one particular bush and get really frisky. And the herders thought, "Well, we're going to try this too." And somewhere along the line they learned to roast the beans, and we had coffee.

Now, it would seem to be maladaptive, though, to use these plant drugs. It does make creatures more mistake-prone. Animals that get high blow child care, make lots of mistakes, have accidents, ruin their health. There's an herbivore that will eat a psychoactive lichen off of rocks until it has completely destroyed its teeth and can no longer eat and thus dies. Yet plant drugs do have utility. On our evolutionary journey, something that gives us pain relief, or lends us mental acuity

in the case of things like coffee, something that helps smooth the waters of social relationships, helps us work and to hunt—these things are useful. Many cultures use drugs in a very specific way, right before the hunt to give them powers of endurance and things like that. So they can also be powerful mental tools on life's journey.

Drugs also can relieve existential pain and boredom. There's this very depressing quote from Huxley: "Most men and women lead lives that are so painful, at the best, so monotonous, poor, and limited, that the urge to escape, the longing to transcend themselves, if only for a few moments, is and has always been one of the principal appetites of the soul."

Are plant drugs or psychoactive drugs good or evil? I think, like a lot of things in life, that the answer to the question is "both." They're both a blessing and scourge. The Greeks pretty much had it right. They had one word, *pharmakon*, that meant both medicine and poison.

Now to pot, to marijuana, to this particular co-evolutionary relationship. Why did this plant make THC in the first place, THC being the main psychoactive ingredient? It certainly wasn't so people could get high. Marijuana did not produce THC so we could change our consciousness. It probably produces chemicals for its own purposes, and these are still unknown. There are theories. One is that THC helps protect the plant against insects. Another theory is that it helps protect against ultraviolet radiation. You find more THC as you go up higher in elevation and you have more UV rays. Another is that it's an aid to help the plant defend itself against predators. And if that's true, it's kind of a brilliant defense. You know, when you're playing around with the arms race between plants and their predators, outright poison is sometimes not the best way to go. When you put out a powerful poison, you select the resistance, and very soon, you've developed it, and the poison becomes ineffective, as we find with pesticides all the time. But think how much more clever it would be to have a defense against predators that makes them forget where they saw you last time?

Now, I have some firsthand experience with this.... Well, secondhand, actually, not exactly firsthand. My cat has it firsthand. I grow catnip for my cat; he definitely has a problem with it. And during the garden season, every evening when I'm harvesting something for dinner, he comes down to the vegetable garden, and he waits to be let in. I open the gate and he comes in, and he wants to

find his catnip. And every night, I have to show him where it is again. Catnip is very different from THC, but you can see the usefulness of a chemical that would cause the predator to forget where you are. That's my own theory. I hasten to add I don't think there's any science behind it.

Marijuana was discovered, it appears, in Central Asia, perhaps thanks to birds. Pigeons love the seeds of marijuana, and get a little tipsy on them. And this may be what tipped people off to what it was. It was probably purely accidental that this plant, this chemical, happened to be active in the human brain. But that's no different from any other of the accidents on which evolution and co-evolution are built. The plant seized on this accident.

Marijuana became one of the earliest plants to be domesticated. Its first use, by the Chinese, was as fiber, hemp. It's been so changed by its 15,000 years of co-evolution with us that apparently marijuana in its wild form doesn't exist anymore. We don't really know what the plant in the wild was like, how psychoactive it was, how good a fiber it was. The plant comes down on two lines of co-evolutionary descent, which is very interesting. You start with the same plant, but over time you develop one plant for the fiber—marijuana has the longest, strongest fiber. We're not going to talk about hemp very much, but that's how the Chinese started with it. It was, in fact, the most important fiber for both paper and cloth, up until the invention of the cotton gin in the nineteenth century. On that path of descent marijuana moved west from China, to Northern Europe, and on to America.

The other path of descent was as a medicine, and people selected that strain for stronger and stronger medicine. It was used for pain relief, help with childbirth; as an anti-inflammatory, antispasmodic, anti-anxiety drug; and as a treatment for insomnia. On its second path, it moves from Central Asia, down into India, and to Africa. And from Africa, it appears to come to the "new world," to South America first with the slave trade, and then it comes up from Egypt to Europe with Napoleon's army returning to France. So it came kind of late to Europe.

Along the way, we changed the plant, selecting for either a better fiber or a stronger drug, and the plant changed us—individually, by giving us this tool, helping us with pain and that sort of thing—but also collectively. And, of course,

that's something else that plant drugs do: besides being mental tools, plant drugs work on us at this higher level, at a cultural level.

Now I'm entering a very speculative area, and this is where I hope I can inspire someone to take this further. You could write—and a few people have tried—a natural history of religion, in which you would find, or speculate, on the role of plant drugs in a great many religions. In many traditions, cannabis has been used. The Shamanic tradition in South America, Indian religion; also cannabis in witchcraft. Cannabis was used as an anti-sacrament in medieval witchcraft. There's also wine, which was mixed with other things in ancient Greece.

Drug plants have been a bridge between our world and other worlds. To what extent? We don't really know. But the 60's literature about this can be kind of dubious. But a historian of religion writing in 1962 asks: "Which is more likely to happen first? The spontaneously generated idea of an after life, in which the disembodied soul liberated from the restrictions of time and space experiences eternal bliss, or the accidental discovery of hallucinogenic plants that give a sense of euphoria, dislocate the center of consciousness, and distort time and space, making an outward and greatly expanded vista?" If you put it that way, you know, it's hard to imagine this idea of an alternate universe, or a heaven, or a hell without drugs. But who knows?

I also think you could write—and it would be a very interesting book—a natural history of the imagination, looking at the role that plants, drugs, and fungi have played in certain movements in our cultural history. We know that many of the great thinkers of ancient Greece participated in an annual religious rite at which a hallucinogenic potion was consumed; for example, the mysteries of Eleusis, a harvest festival for Demeter. Everybody was sworn to secrecy about what was going on, but the theory is that ergot, a fungus that grows on grain—which ties into the Demeter thing— was consumed. At a molecular level, ergot is very closely related to LSD. We don't know what impact, if any, this had on Greek thought. It seems almost impious to suggest it had any, but what would we think if we discovered, say, a secret manuscript telling us that Plato's metaphysics were the result of his drug trips? For sure, one of the effects often reported by people who have used drugs could be called the Platonic effect. I'm quoting one writer, who talked about how under the influence of drugs "a cup begins to look like the Platonic ideal of a cup, a landscape looks like a landscape painting, a Jerry Garcia

guitar solo sounds like the music of the spheres." Drugs can make people feel as though they've been admitted to this realm of archetypal forms. A highly provisional idea.

Less provisional, though, is the role of drugs in romanticism. Coleridge spoke of it, and attributed to opium his notion of suspension of disbelief. There is also the idea of the secondary imagination, this faculty that starts with the world of fixed and dead objects "dissolves, diffuses, dissipates, in order to recreate." This is an entirely new mode of imagination, and moving towards something much more like modern art. And this idea is owed to experiments with opium.

David Lenson, an interesting literary critic and musician, has written a great book, called *On Drugs*. I recommend it, though it got very little attention when it came out a couple years ago. Lenson writes: "Our operative idea of imagination, dating back to the tail end of the eighteenth century, is inextricably linked to our history of intoxication. However criticism has tried to sanitize this process, we have to face the fact that some of our poets and theorists when apparently talking about imagination are really talking about getting high."

Another area to look at, which Lenson looks at too, is improvisation. It's an amazing invention: folk, jazz, and rock improvisation. Without THC, specifically, I think improvisation is a very hard thing to imagine ever happening. I'm thinking in terms of the breaking of the linear flow, and the spatialization of time that goes on. And if you look at the history of rock and roll, you find that even a lot of the musicians whom we think of as acid or LSD-influenced restricted themselves to cannabis when they were performing, and that acid was a whole other part of their lives. But THC was the drug for improvising. Lenson talking about this now more as a musician, says, about the solo, "What is shared, the melody, is now his or hers to diffuse, dissolve, dissipate and recreate. The song's spatial aspect is redrawn, the improvisational expanse must be filled. Pot makes improvisational space virtual, opening dimensions and possibilities, so that the apparent infinity is interesting, rather than terrifying. Marijuana, the most user-constructed of all drugs, is the great yea-sayer, supporting and encouraging whatever is going on anywhere, and introducing very little of its own, or nothing of its own. It helps you understand that there is no predetermined right or wrong thing to do with the enormous space at your disposal, there is only what you do."

With this very sketchy idea of a naturalistic imagination, I come to my second disclaimer. I don't want to sound like I'm offering a brief for drug use. I see drugs acting on human culture as mutations, in the same way that we understand that ultraviolet radiation creates mutation in genetic copying. Mutations are mistakes, and 99% of them are disastrous for the creature. Yet mistakes are a very important part of cultural evolution. Think of Harold Bloom's idea of the creativity of productive misreading. If nothing else, drugs lead to plenty of misreadings, most of them stupid. But every now and then, one comes along that changes everything. And that's really what I'm talking about, that drugs can do this for us.

Let me go bit more into the harder science. One of the hardest clichés of the 1960s was that drugs like cannabis and others would unlock secrets of consciousness. Well, it turns out that Timothy Leary, Alan Ginsberg, and others were sort of right. THC, in particular, has thrown open a door onto the workings of the mind that they never would have imagined. We have learned things about neuroscience by studying cannabis. So the answer to understanding consciousness through drugs is from studying it, not from smoking it.

Trying to figure out how this plant works, Raphael Mechoulam isolates THC, Delta Nine Tetrahydrocannabinol—an important moment for neuroscience. And then a couple years later, in 1988, a researcher at St. Louis University, named Allyn Howlett, discovers receptors in the brain and elsewhere, some very interesting places that THC activates. One of those places is the uterus, which in view of the history of the drug helping with childbirth, makes a certain amount of sense. He hypothesized that humans did not have these receptors in order to respond to THC in particular, so therefore the brain must produce another chemical—an endogenous cannabinoid—that these receptors were designed to interlock with. Four years later, in 1992, Mechoulam discovers what this endogenous cannabinoid is, and he names it anandamide, which is the Sanskrit word for inner bliss. This is a man working in Israel and not in the U.S., under a grant from the National Institute of Drug Abuse. I don't think that that name would have washed here. Later, another cannabinoid called, less poetically, 2AG was also discovered.

The question arises, what do we have this endogenous cannabinoid receptor system for? This is where it gets really interesting. Anandamide works very much like THC, but as a neurotransmitter it needs to be shorter-acting. You

don't want your neurotransmitters hanging around in the brain for too long, or you'll just get clogged up with stuff. So they break down very quickly. You have re-uptake of your serotonin and things like that. But it does everything THC seems to do. It affects your short-term memory, pain, emotion, and appetite. One way you can prolong the effect of anandamide once it has been released in your brain, interestingly enough, is with chocolate. People often talk about the effects of chocolate on mood. Not so much that it's a drug itself, but it seems to prolong the effect of other drugs in the brain, anandamides specifically. And that may be why it makes us feel good.

I want to focus on memory, but this exploration of anandamide and 2AG has opened up some other interesting things, and one, of course, is appetite. The neuroscience of the munchies has basically been discovered. This just happened. Scientists were able to breed knock-out mice, mice that don't have these receptors, and they found something very interesting. These knock-out mice do not nurse. They do not have the desire to suck at their mother's breast, and they eventually die. But if you then administer THC to them, their appetite is restored and they thrive. So it appears that anandamide acts in a kind of see-saw relation with another chemical called lepton, the brain's signal for satiety. This opens up enormous possibilities for control of appetite, a very significant finding.

There's also been a lot of work done on another constituent of marijuana, cannabinoid, which is not psychoactive by itself. A lot of research has shown that it's a great anti-inflammatory, it's a neuro-protectant, and it may be what gives medical marijuana patients relief from things like epilepsy and anxiety. Now that cannabinoid can be separated from THC, you can actually produce a non-psychoactive kind of drug, but there are a lot of patent issues. Well, actually, no one wants to develop a plant drug because you can't patent it, so nothing is happening with the discovery. There is a company, though, in England, GW Pharmaceuticals, that's in stage three trials with a cannabinoid aerosol that you put under your tongue, that they're hoping to sell as a help for MS patients.

But back to this neuro-network and anandamide. I asked both Howlett and Mechoulam why we have this cannabinoid system in the first place. Remember, it works just like THC. It's involved with pain relief, loss of short-term memory, sedation, mild cognitive impairment. Howett said, "All those things that you've just said are exactly what Adam and Eve would want after being thrown out of

Eden. You couldn't design a more perfect drug"—this is her quote to me—"for getting Eve through the pain of childbirth and helping Adam endure a life of physical toil." She's basically saying that this is a brain-zone drug for coping with the human condition.

Mechoulam had an even more interesting take on it. He thinks anandamide would be found to be crucially involved in emotion. For example, if the experience of seeing his grandson entering the room brings happiness, the brain's cannabinoid could be the missing link that "translates" the objective reality of the grandson rushing toward him into a subjective change in his emotions.

But then I asked Mechoulam, "Why would we evolve a chemical that would make us forget, that would affect our short-term memory?" That seems maladaptive. His answer was one of the great "a-ha!" moments I had when I was working on this book. He said, "Well, do you really want to remember all the faces you saw in the subway this morning, all the faces in the supermarket?" And I realized at that moment, well, of course, forgetting is not a defect of a mental operation, although it can certainly be that; forgetting is a mental operation. It's almost as important as remembering. He believes that there is another see-saw there. There is a chemical that helps us lock in memory, and anandamide works on the other side to make us get rid of memory.

This also relates to memory loss with regard to trauma. We need cannabinoids to forget horrible things that have happened. Scientists have worked with mice that got an electric shock every time they heard a certain tone. This conditioned them to be fearful when they heard the tone. When you play the tone for normal mice, the first time they react fearfully, but over time if you play the tone enough they forget and they just go about their business. And this is what happened. But these pre-conditioned shock-treatment mice that cannot use the anandamide their brains are producing never forget the fear—it is never extinguished. So I think it's very interesting that if we didn't have anandamide we might not ever be able to get over things like post-traumatic stress phobias and neuroses of various kinds, even chronic pain. It's often been observed that pain is the hardest of all experiences to summon with memory. You know something felt really bad, but it's very hard to recreate that emotion the way you can recreate other emotions, and it may be that we have the cannabinoids to thank for that.

Now, as I looked for literature on forgetting, I found that there's very little of it. There's a lot more on memory, which makes sense, I guess, given that memory is crucial to identity, to culture. But I would argue that forgetting is really crucial, too, for our psychological health, for certain spiritual experiences, and even for learning. Memory is important for learning, but so is forgetting. One great thinker who has written a little bit on forgetting is William James. Daniel Boorstin, in *The Discoverers,* quotes James: "In the practical use of our intellect, forgetting is as important a function as remembering. If we remembered everything, we should on most occasions be as ill off as if we remembered nothing. It would take as long for us to recall a space of time as it took the original time to elapse." That's a kind of spacey idea. And James goes on, "we should never get ahead with our thinking. All recollected times undergo foreshortening, and this foreshortening is due to the emission of an enormous number of facts which shield them. We thus reach the paradox of the results"—he is such a blind writer, isn't he?—"that one condition of remembering is that we should forget. Without totally forgetting a prodigious number of states of consciousness and momentarily forgetting a large number, we could not remember at all." A very sweet idea.

We actually do have one great case study of a man who remembered everything. I don't know if any of you are familiar with a book by the great Russian psychologist, A.R. Luria, *The Mind of the Mnemonist*. Luria is a very interesting writer, he's the model, I think, for Oliver Sacks' work. Luria wrote a book about a Russian Jew he treated in the 30s whom he calls "S." Any sequence of words or numbers or abstract symbols he presented to this man, he could remember and recall. The limit of his memory was never reached in any test he took. He could bring it all back indefinitely. He saw the figures as images, everything presented itself as sheets of paper, and he could see all the numbers you gave him. He could recite them forwards or backwards or any way you wanted. He visualized it all, sort of like a memory palace. And he became a mnemonist, a professional memory performer, and he went and did three shows a day, where people would put forth these outrageously long list of words and things, and he would remember them all.

But as time went on, "S" became tormented by his inability to forget, either long or short-term. Luria says that "Traces left by one stimulus did not inhibit those of another. They showed no signs of becoming extinguished with

time, nor did they become any less selective with the years." Images of these numbers and words he was memorizing in these performances would just come unbidden to his mind, and they began to drive him crazy. And he devised mental exercises—he did visualize everything—where he would actually crumble up these pages in his mind and burn them, throw them in the fire. And then he would look in the fire, see the crumbled paper, and still make out the words and images and numbers. It was a torment. And when you read him a story, every word summoned another image, so that if you said, "The man leaned on a tree," "S" would get this image of a forest, and then if the next line was, "And he looked into a shop window…." You get the idea. "S" is quoted as saying, "No, this is too much. Each word calls up images, they collide with one another, and the result is chaos; I can't make anything out of this."

Just imagine if you couldn't lose images that came into your mind. "S" couldn't get the gist of a story or an argument, because he couldn't forget what wasn't important. All that suggests that abstracting, or distilling, depends on forgetting, depends on mental editing. "S" had to learn tricks for forgetting the way we have to learn tricks for memory. He would close a white curtain, the image would disappear, and that seemed to work. Perhaps "S" was like those preconditioned shock treatment mice.

Friedrich Nietzsche is the other writer who has written about forgetting. An essay written in 1876 called "The Uses and Disadvantages of History for Life," is just a paeon to the virtues of forgetting. It starts like this, "Consider the cattle, grazing as they pass you by. They do not know what is meant by yesterday or today. They leap about, eat, rest, digest, leap about again.... And so from morning until night and from day to day, fettered to the moment and its pleasure or displeasure, and thus neither melancholy nor bored." No mnemonist here. "A human being may well ask an animal, 'Why do you not speak to me of your happiness but only stand and gaze and me?' The animal would like to answer and say, 'The reason is I always forget what I was going to say,' but then he forgot that answer too, and stayed silent." It's a great essay, and he's talking about how cheerfulness, the good conscience, the joyful deed of doing anything really depends on forgetting. He's very much like Emerson and Thoreau in this. He believes you can't have a great passion without conviction, or without forgetting. He says those who can act are those who, "forget most things, so as to do one thing." To do, or

I would add, to think or to feel, and certainly to write. I know writing for me involves prodigious amounts of forgetting. And all this I'm very attracted to, because I have a terrible memory. This is always a consolation to me. But Emerson and Thoreau, too, have this idea of laboring under the weight of convention in the past, and nature became their technology to help them forget and to push things out of the way.

To paraphrase Nietzsche, the ability to forget most things in order to attend to one is the key to what I hope is going on, still, in this room right now. Your ability to attend to my words, think about it, depends on forgetting 99% of the sense information coming in right now. Think about all you're not thinking about right now, just for a second—the discomfort of your chair for sitting this long, the roar of the ventilation systems, the lights, the architectural detailings, the screen, your dinner plans, your homework, the taste in your mouth, the smells, how all of this talk of intoxication, maybe, wants you want to have a drink or maybe something stronger. I mean, forgetting is not just about the past, it's an important thing to remember. To be here now depends on forgetting a great deal of sensory information in the near present, and even forgetting the future, too—worries, anticipations, intentions, all these things can be forgotten also.

So what I'm suggesting is that anandamide is crucial to this operation, to editing out all of the near-term memories, so that you can attend to what is before you.

Andrew Weil, as I mentioned earlier, talks about a lot of this in *The Natural Mind*. "Disturbance of immediate memory," he says, "seems to be a common feature of all altered states of consciousness in which attention is focused on the present." So I think this goes beyond the altered states of consciousness. We've been talking about cannabis, but sport gives it to us also, and thrill-seeking, any of the different technologies we have for immersing ourselves in the present. "You cannot toe that line," Thoreau said, "without ridding yourself of the past and the future."

This notion of the present is the goal of meditation, and it's the goal of experiencing what we call transcendence. The seeker, the spiritual seeker, if you think about it, works to put aside past and future, the better to toe the line of the present moment. There are many examples in both Eastern and Western thought, where this experience of the present becomes our door onto eternity. In the West,

Boethius said, "The spiritual goal is to hold and possess the whole fullness of life in one moment, here and now, past and present, and to come." And there's the Zen master who said, "Awakening to this present instinct we realize the infinite is the finite of each instant." What I'm suggesting is we can't get from here to there without first forgetting, and we will find that it is the cannabinoids that mediate this process.

But isn't there something a little artificial about this? How does this make us feel? Is a chemically conditioned spiritual experience any less real? Does it make a difference that the chemical involved is endogenous or artificial, and why? Huxley wrote about this a little bit. He said that all our experiences are chemically conditioned, of course, and if we imagine that some of them are purely spiritual, purely intellectual, or purely aesthetic, it is merely because we have never troubled to investigate the internal chemical environment at the moment of their occurrence. So humans have found many ways to fiddle with their brain chemistry. And that's exactly what's going on—meditation, fasting, risk. Even with the placebo effect, we're not just fooling ourselves into thinking we're happier when we take a placebo antidepressant, we're actually producing more serotonin.

So why does using a plant like cannabis still strike us, for spiritual purposes, as false and cheap? Is it the work ethic—no pain, no gain? I think the problem is really the provenance of those chemicals in this case, that they come from outside us, and even worse, that they come from nature, from plants. We have a name for someone who believes spiritual knowledge might come from such a corridor, and it's pagan. And we have the story about that, and it's called Genesis. So what was the knowledge God wanted to keep from Adam and Eve in the garden? I would argue that the content was not nearly as important as the form, that there was spiritual knowledge to be had from nature, from a plant. The tree in the garden was a seriously psychoactive plant, and the new monotheistic faith had sought to break the human bond with magic nature, to disenchant the world of plants and animals by directing our gaze to a single God in the sky. But this new God can't just pretend the tree of knowledge doesn't exist, not when generations of plant worshiping and consuming pagans know better. So the tree of knowledge is allowed to grow in the Garden of Eden, but ringed around it now is the powerful taboo—taste it and you will be punished. And interestingly, the

punishment involves remembering, involves falling into history and shame. This, I suggest, is the drug war's first victory.

But I want to end on a much more positive and, well, intoxicating note. This is a passage from my book: "Plants with the power to revise our thoughts and perceptions, to provoke metaphor and wonder, challenge our engrained Judeo-Christian belief that our conscious waking selves somehow stand apart from nature, have achieved that kind of transcendence. Just what happens to this flattering self-portrait, if we discover that transcendence itself owes to molecules that flow through our brains, and at the same time, through the plants in the garden, if some of the brightest fruits of human culture are, in fact, rooted deeply in the earth with the plants and fungi? Is nature then, as Sartre claimed, mute, or might it mean that spirit is, in fact, part of nature, or there may be no older idea in the world?" In *The Birth of Tragedy*, Friedrich Nietzsche described intoxication as "nature over power and mind, nature having her way with us." The Greeks understood that this was not something to be undertaken lightly or too often. Intoxication for them was a carefully circumscribed ritual, never a way to live, because they understood that Dionysus can make angels of us or animals, it all depends. Even so, letting nature have her way with us now and again still seems like a useful thing to do, if only as a check on our hubris, if only to bring our abstracted upward gaze back down to earth for a time. What a re-enchantment of the world that would be, to look around us and see that the plant and the trees of knowledge grow in the garden still.

Audience Comments
on Pollan's Avenali Lecture

COMMENT: I was wondering how cannabis could affect someone who is in recovery from traumatic brain injury? Would you happen to know that?

POLLAN: Well, I know a little bit. Cannabinoid has been used in experiments with mice that have had traumatic brain injuries, and apparently has been very productive and very helpful. This company, GW Pharmaceutical, is doing the most work on it. But if you did a web search on cannabinoid, I think you would find some interesting things about it.

It has also been tested on arthritis with success, and epilepsy, and MS, with some very promising results. One of the reasons that people can't use it and it's not allowed is, well, one, it can't be patented, and, also, it has this horrible side effect for people who are really sick, which is euphoria. So that's one of the reasons that patients can't get it.

COMMENT: You mentioned that you can't patent a plant drug, and yet in the book, you talk about patenting genetically altered potatoes…

POLLAN: Well, there's the exception to the rule.

COMMENT: Yes, that was confusing to me. Explain a little about that.

POLLAN: Genetically modified plants can be patented. Hybrids can be patented. Some hybrids are sufficiently novel. But cannabinoid or a tincture from a

marijuana plant, you know, unless you could prove that you've got a novel hybrid, you can't patent. What you can patent are the extraction methods.

COMMENT: What is the relation of the uterus to the cannabinoid receptors?

POLLAN: That's a good question. I mean, I talk about other desires in the book. I talk about four different desires. They do tend to be a little bit on the heady side. The presence of the receptors in the uterus appears to be involved with pain, but we don't really know. The phenomenon is often described as, "Well, if women could really remember how bad labor was the species wouldn't go on." And the fact that the memory is moderated to that extent may have to do with that. But in terms of other, you know, more sensual desires… it's a great question. I don't know the answer.

COMMENT: What sort of backlash have you had from Monsanto and the beef industry?

POLLAN: There's a chapter in the book on genetically modified plants, because that's really where we're moving in this relationship with plants. I grew a genetically modified potato that I had obtained from Monsanto in my garden. I had wonderful access; they let me walk through their labs, and learn how it was done. I don't think I could write another piece on genetically modified food and ever get into another company like that again. Some of these pieces are pieces you can only do once, because once you've published your views, your access ends. I was able to approach Monsanto as a gardener, which sounded very benign to them, I think, and I think that was one of the reasons I had success. Although, at the time, you know, their technology hadn't gotten a lot of negative coverage in this country, and they saw me as a way to tell their story to the *New York Times*, who I wrote for originally.

From the beef industry I haven't heard anything directly. I know they're very unhappy with me, and, again, I'm not going to write another article on the beef industry any time soon. The ranchers I wrote about—she's referring to a piece I published last spring, where I bought a steer and followed it through the

process—the ranchers actually finally sent me the money they owed me. They were so mad for so long, and I finally discovered that I had actually lost $35 on the deal. That's how rough the beef industry is.

One of the hardest parts of doing this kind of journalism is that very often you don't make friends. You hopefully don't make any mistakes, so that they can't nail you on anything like that. But they're also not very happy. Sometimes people will let you come back because they're so confident that they have a good story to tell. I've written a couple of pieces on Celebration, Disney's community in Florida. And they keep letting me back. You know, go figure. But it's the least happy part of the process; you do make people unhappy. And in the case of Monsanto, I think of that very foolish press person who said, "Our job is not to ensure the safety of these products, that's up to the FDA." He lost his job. But that's for what he said.

COMMENT: Do you have any views on plants and consciousness? Do you talk to your plants? Do they talk to you?

POLLAN: I'm sorry, I'm kind of a Western skeptic on a lot of this stuff. I mean, my plants don't talk to me. They talk to other people. Plants do have certain forms of what someone might call consciousness. I mean, you know, they communicate with one another. You have a stand of oak trees, and some insect attacks the ones on the periphery, they'll send a chemical signal to the ones in the middle, and those will produce a chemical to defend themselves. But, you know, beyond that, I remain a skeptic.

COMMENT: I was wondering if you can really consider cultivated plants evolutionarily successful, because, say, your potato would have no success in the wild without the manipulations of humans, and if that's the case, are they evolutionary, or at least accessible, because of their attractiveness to humans?

POLLAN: Sometimes it's very hard to see humans as part of nature. The assumptions of your question are that we are somehow different, that a plant that has evolved to be dependent on us is at a disadvantage. It's really not—it's just the opposite. We're not going away any time soon. If there's any kind of hidden

message to my book, it is that we are as much a part of natural history as anything else. Domesticated plants, we tend to disrespect in a funny way. I mean, I found this writing about animal rights. The animal rights people hear this a lot: "Well, pigs won't exist without people eating pork, because they're domesticated animals…" Actually, pigs could survive, but chickens or beef cattle would go extinct. Animal rights people tend to say, "Fine, that's great, you know, we won't miss them. They're not free enough, they're not wild enough." I don't have any patience for that attitude. Mutual dependence, interdependency, is how nature works. I don't think of these plants as weaklings in any way, or any less impressive than the tree that would survive without us.

But I can totally understand why someone would think otherwise. Underlying your questions is cultural worship of the wild and wilderness. We look to nature for that which stands apart from us, you know, pristine and unaffected, and has that autonomy. And that is certainly a wonderful part of nature, but the part that is the product of our presence, that is the largest force in evolution right now. And the great winners in evolution, if we have to cast it in those terms, are the species that have learned to take advantage of our presence. There are, you know, fifty million dogs in this country and ten thousand wolves; the wolf if the ancestor of the dog. There's a glamour we attach to the wolf because of that, but in evolutionary terms, it's the dog who came up with the more effective strategy.

COMMENT: Are you saying that dogs are more highly evolved?

POLLAN: Well, dogs tend to get the better of this relationship with us at this point. I mean, when our relationship started they worked for us for awhile. Now, we work for them.

COMMENT: I'm going to ask you to improvise. If you take desire and reason, in our culture today, it is reasonable to not let our desires overwhelm the reason, and, therefore, become dependent on the marijuana plant.

POLLAN: I'm not sure I follow the question.

COMMENT: What would be the difference between desire and reason, if we have a desire to alter our consciousness on one level, we have a culture on another level that says "don't do that too much because you can't function within this culture."? How would you place that?

POLLAN: Well, I mean, I think there is a war. There is a war between, you know, the Appolonian and Dionysian as Nietzsche put it, and the plants are also very much on the Dionysian side of the equation, and that's one of the things that makes them very threatening to civilization. On the other hand, there are exceptions. There are things like coffee, tea, and nicotine, which were evil drugs until in the industrial revolution people figured out, "Oh, people work better with these drugs." You can look at a culture and see what it values. A lot of the drugs that we say are okay or have said are okay, tend to work very well with capitalistic systems.

Desire is an interesting question. You can also make a distinction between desire and pleasure—and now I'm going to improvise. There are drugs of desire, which I don't think marijuana is. I think cocaine is a drug of desire. Desire is about the future, in a way. Desire is always pitched forward, and that's what the cocaine experience is about, whereas marijuana is very much about the present, which is about pleasure, satisfaction. You know, a Marxist-type critique of all this would be that marijuana is frowned upon because it doesn't do anything to make you want to buy things. On marijuana, anything is really interesting, anything in front of you—these flowers, this desk, this room, it's fine. I don't need anything else. I don't have to go to the movies, I don't have to buy anything. Cocaine is very much a drug of desire and futurity and endless dissatisfaction. So it is, in a way, the perfect drug for a commodity culture. That's one way to look at it, there's my improvisational rift.

I thank you very much. Great questions.

Commentary

Michael Pollan

I think what I'll do is talk and try to lay out what strikes me as an important general theme, at least one that keeps coming up in my own work. I've been looking at this question of ecology and food for four years now. And I've written a series of articles that are sort of chapters in my education—articles, really, that are kind of first-person forays into the food chain. My governing assumption in going into all this—my interest in food—is that I come at it as a nature writer. Nature writers don't often write about food, but it seemed odd to me that they don't, because food, what we eat, is really one of the most important ways in which we engage with the natural world. We don't really think about it that much when we're contemplating what's on our plate or what we're buying at the grocery store. So I asked myself what I would find out if I looked at food this way. And so I wrote a piece on genetically modified potatoes, which I got from Monsanto and grew in my garden a few years ago. I wrote a piece following an organic TV dinner from the grocery store, back to the farms where it was grown. I wrote a biography of a steer last spring, and the piece in the Sunday *New York Times* about animal rights.

All of these, I thought, were very different stories. And all of them kept bumping into very similar tensions and conflicts that I really do think were at the heart of what's going on in our food system. And that is that there is this fundamental, inescapable tension, I think, between the logic of natural systems and how they work, and the logic of industrial capitalism and how it works, and what its

needs are. And you find this in animals, you find this in crops and their parasites, and it's at that crossroads that so many of our problems with the food system crop up.

Just to give you a couple of examples: when I wrote about genetic engineering, I got these new leaf potatoes from Monsanto. This story is in the last chapter of my book and it was originally published in the *New York Times*. I expected the basic narrative of the piece to be the revolutionary new technology: what are the risks, what are the benefits? Do the benefits outweigh the risks? And I'd be looking at environmental questions and health questions, the old versus the new. But it turned out that this is not the interesting question, really, or the really significant divide. What we are really talking about is two systems. There is, on the one hand, the industrial way of growing food, which is crucially dependent on monoculture, that is to say, growing lots of the same thing in the same place at the same time, versus another way of doing it, often practiced by organic farmers and traditional farmers that you could call polyculture, which means producing many different crops. That is the key divide. And that is what is really going on with biotechnology. I don't know if this is inherent in the technology or inherent in the way it's being applied—I tend to think the latter—all these wonderful things it promises to do are really ways to save monoculture from collapsing, because monoculture is in really big trouble.

The Colorado potato beetle is the ostensible target of the new leaf potato. This is a potato that has been engineered to produce its own pesticide in every cell. The Colorado potato beetle is a big problem for farmers who are growing huge potato crops in places like Idaho and western Washington and Oregon. Interestingly enough, though, the Colorado potato beetle is not a big problem on organic farms, where you have polyculture. And the reason that we need a new leaf potato or the reason the industry thinks it needs the new leaf potato is that the pesticides used on potatoes don't work as well as they once did, because monocultures, eventually, breed resistance. If you use any pesticide enough, the pest will evolve an invulnerability to that chemical. And it's very hard to introduce new chemicals, so the industry really turned to this technology to bail itself out. So the perception is that this is a technology that solves a beetle problem, rather than that the beetle problem is a problem of monoculture. So there is a Band-Aid quality to it, as far as I can see.

Monoculture is a very powerful idea. It's really crucial to the way industrial agriculture works. It gives you the economies of scale you need. Without a monoculture, you can't scale up to giant combines. You can't have one great potato, like the Russet Burbank, you know, which is in just about every french fry you've ever eaten at McDonald's because it's the nice, long french fry that comes out of those red boxes like a little bouquet and they will only use Russet Burbanks. That idea of marketing one ideal of a french fry to the whole world dictates a monoculture, because you've got to grow enough of that potato to satisfy that Platonic ideal of what a french fry should be. It's very interesting that the system has been confronting this problem of monoculture. I think this is a really classic problem of our incredibly creative capitalist system, that, rather than go back and fix the systemic problem, it creates a new business to fix the problem without solving it. It's very expensive, very high capital, and there's a whole new industry that can make money off of this problem.

But biotechnology is also very well suited to industrial capitalism. I won't really talk about how well is it suited to the natural world now. But it's beautifully suited to the way capitalism works. Not only does it help you rescue monoculture, it promotes monoculture because you're using similar traits across many different crops. Also, because bigger companies are selling the potatoes, it allows for more consolidation. It also is perfect for patenting, and even more important, patent enforcement. Because when you genetically engineer crops, it's very easy to prove that it's novel and that you own it. It's almost like putting a bar code on every leaf of every plant in the field, because the people at Monsanto can take a little snip off the corner of a leaf and do a test right in the field and say, "This is our intellectual property." So it takes nature and converts it into intellectual property in a very beautiful way. One of the impediments to capitalism in nature has been this very wonderful or annoying fact about plants, which is that they keep making more of themselves. They have seeds. They create seeds, and you just can't control this. You can sell a hybrid—a great hybrid soybean, for instance—and the farmers just save a few of these seeds and replant them. This is like sharing music over the Internet. We have to do something about this, the capitalist wisdom says.

Biotechnology even allows you to take this logic further. There's something called the "terminator technology" that allows you to produce a plant that no longer does that annoying thing of letting you reproduce it *ad infinitum*. The

plant, in the second generation, is sterile, or the seeds produced by the plant in the first generation, are sterile. And then there are whole products created such that the plants will only exhibit the traits you want, whether it's insect resistance, or whatever, after you've sprayed them with your own proprietary chemicals.

People have described it as a new enclosure movement of nature. So you see how, really, this logic of industrialism enters into nature and there is enormous force behind that.

I saw organic agriculture as an alternative, and doing this piece was really my introduction to organic agriculture. So I thought, "Well, I should write about that." This is a wonderful alternative. So I launched on the second chapter in this education. I went into it thinking, "Well, the divide here is going to be conventional versus organic food." That's going to be my story. But what you find, when you look at organic agriculture—and I think people in California understand this better than people in the east—is that this logic of industrial thinking and production has come now to organic farms. So you have this situation of processed food made with hundreds of ingredients sourced from dozens of different states.

But a very interesting thing happened. What I did was I followed this company called Cascadian Farm. Eugene Kahn, one of the pioneers of organic farming, founded it. He was a hippie English major in the 70s who got into organic farming—the classic kind of story. Now he's the vice-president of General Mills, and he's selling organic TV dinners and things like that. They still have Cascadian Farm, the beautiful little picture on the label—that really exists. But now it's kind of a show farm, and I said, "Well, you don't seem to grow any food here." And he said, "Well, this farm is too small. We can't get enough…" If you're selling frozen corn, say, you've got to… you can't buy from small farmers anymore. He described how the processing beast needs two acres of corn an hour to bring a combine through a field. So you've really got to move to large-scale—guess what?—monoculture, which is so opposed to the fundamental idea of organic farming. Also, you have to use all the same kind of corn. You have to use Jubilee, because it's the one that freezes really well, and ripens properly. So what you have is you're developing a new kind of factory farm, an organic factory farm, that is much better than the alternative, but it's still a factory, it's still consecrated to these principles of inputs and outputs. So you have this new thing, industrial organic, which sounds like a contradiction in terms, and I think probably is. And

there is a real question as to whether it's sustainable, whether you can grow organically on that kind of scale.

So there, again, I found that split. There was the kind of logic of natural systems. And there are many organic farms still practicing that kind of agriculture. They're very small and they're about to be swamped. And many of them are being put out of business by the very large ones, particularly in the East Coast, where they can't really compete against the large West Coast organic farms. But the drift, again, is toward this inextricable logic of doing it as monoculture, as close to monoculture as you can get with organic.

For the third chapter of my food education, I did this biography of a steer, which published in the *Times* last spring. I bought this steer and followed it through the whole process. The whole idea of a steer or cow, or any ruminant, is actually a wonderfully sustainable kind of food system, in principle. A ruminant is an animal that can digest grass, something we can't do. This is a wonderful ability they have to take land that we really can't do very much with because it's too hilly, it's only good for grass, maybe it's too arid, and they can, because of these marvelous stomachs, these rumins, which are kind of fermentation tanks, they can convert that grass into high-quality protein. And you don't need chemicals. All you need is a cow, some sunlight, some water, some grass.

But that's not how we do it. The process has been "improved" by industrial efficiency. What happens is you take the cow or the steer, and the first six months of its life it spends on the farm with its mother, after which you take it off the farm and you start accustoming it to eating corn, which cows are not evolved to eat. They haven't encountered corn before. But they can be sort of trained to eat corn, if you give them some drugs to keep them from getting sick. What the new corn diet allows you to do is get to market much more quickly. You can get the animal to 1,100 pounds in 14 or 16 months, instead of the usual two years. So time is money, and you do this. And corn is really, really cheap because we subsidize it. The price of corn is about a dollar less than it costs to grow. And that's because all of us taxpayers pay the difference in subsidies. So this logic is inexorable, again: feed them corn, they'll grow more quickly. Yes, you have to give them drugs, too, but that doesn't cost that much. And you end up with this system which is full of, again, problems.

One is food poisoning. Without going into great detail, when a cow is fed on corn, its stomach is acidified in a way that makes it a very good host for e.coli 0157, the agent that sickens and kills children when they get it in hamburgers. This is not a problem that you find in grass-fed meat. It's not a problem you found anywhere until 1982 or so. So here we have a systemic problem. Feeding cows corn leads to this very serious microbe getting into our food supply. So, again, what do we do? Do we go back and fix the system? Do we start giving them a little more grass because if you gave them five days of grass on the feed lot, their stomachs would no longer be acidic, the e.coli would die, and you wouldn't have nearly the problem we have with it. No, no, no, it's much better to make money on a new fix. And that new fix, of course, is irradiation. So rather than remove the manure with the e.coli from the meat, we just zap the manure in the meat, so the manure that you're eating is no longer toxic.

So you see, again, how the logic works, how it's fighting the natural systems in all these ways.

With animal rights—the piece that I did recently in the *New York Times*—you see a very similar kind of split. But here it's not between an industrial system and a natural system, but between another form of human artifice—our moral system, our moral order and natural systems. And there, too, you see this very interesting clash, and that's what I try to develop in that piece. If you accept that our tradition of moral philosophy is the proper way to look at our relationship to animals, you come out thinking, "Well, yeah, they should have rights, of course," if the standard for moral consideration is relieving suffering. They do suffer. We know they suffer, so perhaps we should give them rights. But is that the right system to bring to the natural world is really the question I dealt with. I concluded that it's not. If you look at things ecologically, you see that the vegetarian utopia has all sorts of problems. You end up killing more animals, actually, because even when you're growing grain and vegetables, many animals must die in this process because of your pesticides, because of your farm equipment. You can't escape killing animals. I cite the work of an animal scientist at Oregon, who calculated that if we all switched over to a vegetarian diet, more animals would die because we'd be taking this pasture land to the extent we're using pasture land and be putting row crops on it and in the combines, and everything, and that would be killing more animals. He makes the case that if you want to kill the least number of

animals possible, you should be eating beef grown on grass, because it's a really large animal on ground that doesn't have to be killed. So that's an interesting argument.

But the vegetarian utopia also, though, is a very urban idea that flies in the face of how nature works, in this sense. There are so many places where you can't grow row crops. Where, as I said earlier, animals, ruminants, are the best way to get food off of the land, to turn sunlight in grass into protein. So you're condemning all those places to being immoral, in violation of animal rights—and these are huge swaths of the world. In the place where I live, New England, where you can't grow row crops, you can grow animals very well. Or you're making people dependent on this industrial system—food that's flown in or driven in from a long way away. People who work in this field will tell you that you need animals to have a sustainable agriculture, to have those systems, that you need the animals to cycle the nutrients, to eat the crop wastes, to give you the fertilizer, if you are going to remove yourself from the industrial system, from industrial fertilizers. Without animals, you're stuck with a highly industrialized system.

So, again, you see that tension. My conclusion, if I have one, is that we need to recognize that there are these tensions and realize that nature may not yield to this constant process of being turned into a factory without a lot of very unpredictable effects. We see them all around us—you know, the epidemic of food poisoning, agricultural pollution, a crisis that we're losing our pollinators, the bees are dying—and that's tied to monoculture. Elevated cancer rates may be tied to what's going on in agriculture, even early puberty. Farms are not factories, and they're embedded in natural systems, and they cannot operate as if they were factories forever.

So I think I'll leave it there and hope that that opens up onto what other people wanted to say.

Commentary

Cathy Gallagher

What I want to do this afternoon is to give you some early iterations of ecology, iterations that come, I think, quite surprisingly, from inside nineteenth century British political economy.

The word "ecology" is a Victorian coinage, introduced by translators of Ernst Haeckel in the 1870s, and derived, by analogy to the word "economy," from the Greek word "Oikos," meaning dwelling, or household. "Ecology" was meant to signify an extension of the notion of "economy" from the realm of human activity to that of plants and animals: ecology is "The science" as the *OED* says in its first definition, "of the *economy* of animals and plants." The connections between the historical disciplines of economy and ecology, or more precisely, between political economy and proto-ecology (proto because not yet evolutionary), go far beyond analogy and nomenclature, though. In the English speaking world, at least, an interest in the ecology of food—human food—was at the heart of political economy and shaped several of its classical premises. A popular understanding of ecology now opposes it to commercial interests—how often do we hear that ecological concerns are in conflict with economic growth?—I'd like to sketch how that very opposition was established, not as a matter of competing specialties but rather inside the discipline of political economy itself.

I'm going to begin this sketch—a bit arbitrarily—with Malthus, because in sections of the first edition of his *Essay on Population* the economic unit of his investigation is not "the nation" or even "the population," but what we now call an "ecosystem," or a bio-economy. And in this bio-economic discussion, which

he later heavily revised or altogether scrapped, Malthus expressed his alarm at how market forces were disabling the production of sufficient available food. Indeed, when considering the contemporary, late 18th-century state of the laboring population, Malthus sounded less like a budding political economist than like a conservative or radical critic of modernity. He expressed the opinion, for example, that working people were probably better off in the early seventeenth century, not because they were increasing too rapidly in the present, but because the fund out of which they were supported—by which he basically meant grain—was not keeping pace with their greater numbers. And he blamed the plight of the poor on the growth of commercial and industrial wealth, which he thought was hiding the real condition of the mass of people by misrepresenting the size of the fund for the support of labor. The false promises of an economy dominated by commerce and industry were, in Malthus' view, tricking the feeble poor into reproducing themselves, not necessarily beyond the country's *potential* ability to feed them, but certainly beyond its realized agricultural capacity. To this relatively new ability of a society to misrepresent the size of its fund for the support of labor—that is, to promise prosperity to urban commercial and industrial workers through high money wages and then betray the promise by offering dear and scarce provisions—Malthus attributed a new dynamic equilibrium of working-class misery.

Moreover, he argued in those passages that the political economy of Adam Smith was part of the problem, for the more a society believes that the nation's wealth equals its *exchangeable* value, the more it believes in the abstract equivalencies expressed, for example, in monetary terms, the more enfeebled the body of labor will become. "It is evident . . . that two nations might increase exactly with the same rapidity in the exchangeable value of the annual produce of their land and labour, [he wrote] yet if one had applied itself chiefly to agriculture, and the other chiefly to commerce, the funds for the maintenance of labour, and consequently the effect of the increase of wealth in each nation, would be extremely different" (109). "The gross produce of the land" he reasoned, is "a more accurate definition" of the nation's wealth. Malthus insisted that Adam Smith had committed a fundamental error in "representing every increase of the revenue or stock of a society as an increase in the funds for the maintenance of labour" (103). Denying Smith's emphasis on the efforts of labor to produce the nation's wealth in myriad forms, Malthus, at this early stage of his thought, agreed with the French

"physiocrats", the *economists,* as their English contemporaries called them, that a nation's true wealth was the product of labor *on the land*.

Malthus blamed the habit of regarding all commodities as abstractly fungible items, the conflation of value in general with exchangeable value, for encouraging unhealthy towns, inflating the money economy, proliferating non-agricultural enterprises, and, ultimately, lowering the overall standard of living among the working population. A political economy that left out of account the commodity's contribution to mass nutrition allowed the pounds of healthy flesh, he thought, rightly destined for productive bodies, to get stuck in the wrong places, such as manufacturing towns, which prevented the flow of capital back to the countryside. But the displacement of potential nutrition took place even in agriculture, where it is most graphically illustrated by Malthus' description of how a surplus of commercial wealth alters the very biological economy of a country to the detriment of productive agricultural labor. Money made in trade and manufacturing becomes, he tells us, an "increased demand for butcher's meat of the best quality, and, in consequence, a greater quantity of good land has annually been employed in grazing" (107). This new distribution of land led to a "diminution of human subsistence, which might have counterbalanced the advantages derived from the inclosure of waste lands and the general improvements in husbandry" (107). Thus a commercial economy reshapes the relative proportions of vegetable, animal, and human matter:

> The present price will not only pay for fattening cattle on the very best land, but will even allow of the rearing many on land that would bear good crops of corn. The same number of cattle [as were formerly raised in waste lands] or even the same weight of cattle at the different periods when killed, will have consumed . . . very different quantities of human subsistence. A fattened beast may in some respects be considered in the language of the French economists, as an unproductive labourer: he has added nothing to the value of the raw produce that he has consumed. The present system of grazing undoubtedly tends more than the former system to diminish the quantity of human subsistence in the country, in proportion to the general fertility of the land (107).

The biological economy envisioned by Malthus is one in which cattle, rather than the proverbial sheep, "eat" men. So many potential pounds of human flesh are converted (through the conversion of land from tillage to pasture) into so many pounds of animal flesh, which, by an undeniable caloric arithmetic, can never be converted back into an equal number of pounds of human flesh. That beast thus stands as an impediment to value as Malthus imagined it; or, more precisely, it stands for the displacement of value. Created by a surplus of money flowing from nonagricultural sources, it is the explicit embodiment of unproductive labor. We might call it the fatted beast of modern commercial society, a striking contrast to the diminished body of productive agricultural labor.

Malthus subsequently modified his definitions of wealth and productive labor, bringing them more closely into line with Smith's and later with David Ricardo's, but even after he capitulated to the orthodox view that industrial labor was no less productive than farming grain, he nevertheless continued to insist on the primacy of agriculture in the nation's economy because a plentiful supply of food, he reasoned, was the basis of all other production. Moreover, one of the arguments he used to demonstrate the uniqueness of agricultural production, its natural difference from industrial endeavor, became a founding proposition of Ricardian economics: the theory of diminishing returns held that "agricultural skill remaining the same, additional Labour employed on the land within a given district produces in general a less proportionate return, or, in other words, that though with every increase of the labour bestowed, the aggregate return is increased, the increase of the return is not in proportion to the increase of the labour."[1] That particular formulation is Nassau Senior's, but, with few variations, it stood as a fundamental postulate of political economy from the 1810s until the1870s, combined with Malthus' proposition that rents in general would be based on the cost of obtaining a crop from the least fertile lands, which were last brought into the cultivation. Higher rents and diminishing returns in agriculture would then lead to a greater share of the total national product going to wages and a proportionate fall in the rate of profit. It was thought that the big difference between manufacturing and agriculture was that industrial improvement made the unit cost of each product cheaper to manufacture (all other things being equal), while in agriculture (given the relative infertility of the most recently cultivated lands) costs would tend to rise even if techniques of production improved.

And eventually the higher costs in agriculture were bound to transfer into manufacturing, "leaving as a general result, a constant tendency towards an increase of capital [going to wages] and population, and towards a fall in the rate of profits" (193).

Therefore, despite the fact that the labor theory of value seemed indifferent to the biological significance of commodities, numerous other facets of political economic theory continually raised the problem of the food supply. The theories of rent, of the wages fund, and of the falling rate of profit, in addition to the population principle, all demonstrate political economy's perennial preoccupation with the physiological preconditions of labor and with the extent to which commodity production and exchange are grounded in transfers of biological energy. In short, classical political economy had formed itself around an environmental dilemma, in which economic growth would always tend toward an unbearably pressured agriculture.

Then, in the mid-Victorian decades, the focus on the biological aspects of political economy both intensified and transformed itself, promising (falsely, it turned out) some new solutions to the old problems. The sanitary condition of Britain became a major concern of a group of political economists, who started a current of thought that ran counter to the orthodox belief in agricultural depletion, rising rents, and a falling rate of profit. The inquiry into "the health of towns" grew directly out of the reform of the Poor Laws through the extraordinary efforts of the New Poor Law's main architect, who had previously been Jeremy Bentham's amanuensis, Edwin Chadwick. Throughout the 1840s, 50s, and 60s, Chadwick and other sanitarians tried to integrate the study of the nation's wealth with that of its health, and Chadwick devised a scheme that would revolutionize, he hoped, the ecology of food, by putting the *city*, hitherto merely a site of food consumption, at the hub of a reconceived cycle of food production. Chadwick's ambition was to overcome the Malthusian dilemma by reasserting and also reimagining the connection between the national economy and its organic environment, its life-supporting resources. In the Malthusian model, production and consumption of food were clearly defined opposites; the energy spent on food production needed to be replaced by food consumption, but the labor became increasingly arduous while the yield became ever scanter. In the sanitarians'

revision, though, consumption itself created by-products, human and other animal wastes, that could be used to grow more food; these wastes were concentrated in the great towns. Sanitarians intended not only to dispose of the waste, which caused disease, but also to put it back into the soil, which would in turn become more fertile. Proposals abounded for returning the organic waste of towns to the earth for use in further rounds of production, many of them asserting that the tendency of food to become dearer and scarcer, the organic underpinning of the falling rate of profit tendency, could be overcome by the proper husbanding of human waste. Showing the kinship between economic and ecological thought in this phase, one popular metaphor held that each nation had a God-given capital of fertilizing elements which generated its food as interest.[2] These fertilizing elements included not only human waste but also (in some proposals) decomposing human bodies. A way had to be found, sanitary reformers argued, to return this capital to the food-producing earth, for if it were not returned, it would not pay sufficient interest in calories to keep the population alive. That is, a model of self-sustaining growth based on the continual recycling of the population's own remains (the more people, the more waste; the more waste, the more food; the more food, the more people; etc.) was imagined in response to the Malthusian-Ricardian theory of diminishing returns. Moreover, the very thing that had seemed most offensive about the cities—the sheer amount of excrement they contained—became newly redemptive.

Chadwick famously wanted to build sewers not only to carry off London's ordure but also to carry it down the river as manure for use in large-scale agricultural endeavors. Given that London did not even have pressurized water or a rudimentary sewer network at the time, Chadwick's was a hugely ambitious scheme. Those who supported it set about making it seem like a practical necessity, largely by publicizing how much recycling of human and other forms of waste already took place in the capital and how much wealth it produced. A complementary tactic was to stress the danger of letting the ordure lie in the city. Although there was considerable disagreement over how large concentrations of decomposing matter caused disease, everyone knew that they did. Life's remains had to be kept in productive circulation, not allowed to wash away in the river or to accumulate into stagnating pools and suffocating piles. Hence dead and decomposing human

matter was organized into the sanitarian's bio-economy as the seeds alike of life and death.

It was a vision that appealed especially to the literary imagination, and writers such as Charles Dickens, John Ruskin, and Charles Kingsley, who had hated everything else the political economists came up with, were smitten with these proposals. Indeed, in the literature of the 1850s and 60s, a reverential attitude toward waste and its retrieval developed: think, for example, of Dickens' *Our Mutual Friend*, or Kingsley's *Water Babies*, or Ruskin's claim that "a good sewer" is a "far nobler and a far holier thing. . . than the most admired Madonna ever painted." Sanitarianism inspired a host of resurrectionist fantasies, which, if I had time, I could trace all the way to T. S. Eliot.

I have to finish this story about the internal tension between political economy and its own proto-ecological thought, though. Despite their claims, the sanitarians did not resolve that tension; their sewer farms proved both economically and ecologically untenable. But by the time their failures were incontrovertibly evident, the vast new grain supplies of eastern Europe and North America had become available, easing the pressure on home-grown British produce. Simultaneously, the marginal revolution in economic theory put an end to classical political economy *per se* and sidelined the previously dominant problematics of growth and distribution. Meanwhile, Darwin had generalized one of the Malthusian principles to explain the dynamics of nature as whole, and that piece of political economy became a starting point for the separate, evolutionary science of ecology. As Haeckel put it, "All the various relations of animals and plants to one another and to the outer world, with which the Oekology of organisms has to do... admit of simple and natural explanation only on the Doctrine of Adaptation and Heredity." All of these events of the 1870s sent ecological and economic concerns off on their separate, and down to our own time, largely antagonistic, trajectories.

Of course, there were always economists interested in food production and ecologists worried about economic feasibility, but the large bio-economic issues tended to recede, only to come roaring back into popular consciousness as a problem for developed countries rather recently. The views I sketched—the pessimistic classical account in which a healthy food supply is always in tension

with profits, and the optimistic Chadwickian view in which we can direct economic activity into ecologically sound channels—no doubt also have their present-day analogues. If this little history has a point, it would be that neither the pessimism nor the optimism about reconciling economic and ecological interests is new. Perhaps in the future, it will seem anomalous for economists not to worry about the ecology of food or ecologists not to worry about the economy.

NOTES

1. Nassau William Senior, *An Outline of the Science of Political Economy* (New York: Farrar & Rinehart, 1938 [first edition, 1836]), p. 26.

2. See Christopher Hamlin's excellent "Providence and Putrefaction: Victorian Sanitarians and the Natural Theology of Health and Disease," *Victorian Studies* 28 (1985), 381-412.

Commentary

Ignacio Chapela

Mike and Cathy, when you warn us about mixing the languages of political economy and cultural studies with cultural history, I really feel worried that I'm going to be driving into these like a ram in a china shop. My language as a person from the Department of Environmental Science, Policy, and Management is bastardized; we call it "interdisciplinary."

So I came prepared for a conversation. And what I wanted to do, really, was to provide a frame for Michael, and to come to the point where I could try and explain who I think Michael is in the larger picture, and why I'm happy that he's coming to the campus.

My point of reference is always very shallow, and I would like to position you, the audience, in it today. I don't know how many people got this news from today's *New York Times*, *Washington Post*, etc., about Prodigene. A company, Prodigene, in College Station, Texas had to recall soybeans. The USDA stopped an elevator in, I think, Nebraska that had been growing soybeans, because the soybeans that were pulled into that elevator were mixed with a transgenic corn that produces a pharmaceutical. They refuse to say what it is, but apparently it's dangerous enough that they decided to stop the elevators and recall the soybeans. There are $2.7 million worth of seed slated, as of today, to be burned. And they are slated to be burned because the less than one acre that was planted to be pharmaceutical-producing corn got mixed in with five hundred bushels of soybeans, and those got mixed in with 500 thousand bushels of soybeans ready to go

into the commodities market, so they had to stop the whole lot which would be a half million bushels.

I've known Michael, more than anything, as a practitioner of environmental science and environmental thinking. It turns out that, yes, indeed, I am a micro-ecologist, but I think you know me more because of the recent work in my lab about a year ago, almost exactly to the date. My lab discovered the presence of something similar to what happened today, but at the genetic level. We discovered the presence of transgenic DNA, transgenic material, in corn, in Oaxaca, Mexico, which is the place where corn was first domesticated, and where we hold the genetic diversity of that second most important crop. And that, of course, was very scandalous news that has been rolling in the main media for the best part of the year.

And how is it that microbial ecologists or even a cultural historian comes into this fray, and all of a sudden these questions appear disciplinary from the landscape of his or her discipline? I think it's not surprising. As a microecologist, I was trained, or I am trained to look at the ecology of that which we cannot see. And I believe that in that world, in the realm of the unseen, in the realm of the microscopic, we are undergoing a major revolution. This is a revolution that has parallels, only, I believe, in the Great Colombian Exchange, what some people refer to as the discovery of the Americas, which from the biological point of view was really the breaking down of very important barriers that existed before this event, this historical event, and that led us, as we all know, to a major reconfiguration of the biosphere, not to speak about human society, politics, policy, economy, everything.

I believe that we are really part of a similar revolution, which is the introduction of transgenic organisms into the environment. The so-called biotech revolution; some people call it the "blue revolution," as it has as its common theme the breakdown of another very important barrier or sets of barriers that were not broken culturally, in cultural history, as well as in evolutionary history before. And this is the barrier of the species—the barrier of what one can exchange in terms of DNA between compartments of the environment that before were separate, that we call species. We have acquired the capacity to break down those barriers and to exchange material—genetic material, informative material—across those compartments.

It sounds very simple. It sounds irrelevant because it happens in the domain of the unseen. But I do believe that it is going to be similar to what we saw in the Great Colombian Exchange. The removing of these barriers will have major consequences that we can only speculate about, and I think Michael has been really good at helping us think, speculate, and try to predict what the consequences will be. I think there are major trends in the way we are proposing to do this transformation, this revolution of the biosphere, ostensibly, to produce food. Originally, the idea was to produce more food, to feed the world, etc., etc. But as we know from today's news, as well as the development of new products, a lot of it will have to do with all kinds of other things that have nothing to do with food production: the production of chemicals, industrial chemicals, the production of pharmaceuticals and all kinds of other things. There is this Pandora's box that has been opened through the breakdown of these barriers.

What are the trends that I see happening out there because of this transformation? Well, first, the same trends, the same type of events that happened with the Great Colombian Exchange. Most importantly, a trend towards homogenization. Michael talked about monoculture and that's one very important way in which humans actively homogenize. But, also, inadvertently, the Great Colombian Exchange resulted in great homogenization of the biosphere—things that used to be different started becoming more and more similar with the transformation of the biosphere through transgenic manipulations. We're going to be seeing a trend towards homogenization in the domain of the genetics of the biosphere.

That, of course, is superimposed or underimposed over the globalization trend, a trend towards the expansion of claims, intellectual property rights claims as well as claims over just ownership and access, as well as the impacts, the globalization of impacts. Whatever I do in my lab here in Berkeley will have an impact all over the world, eventually, over evolutionary time. The manipulations that I'm doing today, I think, will have major repercussions around the biosphere. And, there, I did want to respond to your question: is the biotech revolution changing things only because of the way we're applying it, or because there's something intrinsic in it that makes it different?

My belief is that there is something intrinsic in the manipulation, the transformation, using transgenic DNA biology, that pushes the biosphere towards this homogenization, towards the third trend, which is the microbiolization, if

you will, pulling everybody into this domain of the microbes. Some people call it the "viralization of the biosphere," in which the rules of exchange of genetic material, the rules of exchange of information, are changed from rules that used to be dominant in our time, a time of large organisms, which used to be ruled by highly choreographed exchanges of information. You can think of mating rituals in large organisms, all the way down, if you wish, to the rituals of chromosomal exchange and chromosomal pairing and exchange with genetic material. So there was great choreography going on that doesn't happen when you have the viralization of these processes. All of a sudden, you have almost random exchange or the capacity to produce almost random exchange, random exchange of information and genetic material.

The question for me—and I think the interesting question for this conversation tonight—is: who are we in that revolution? I think it's really important and really interesting for me to see myself as part of that revolution and in the development of that revolution. And I note that most of the technology, or the one technological package that was really important in the Great Columbian Exchange was, of course, navigation technology. Most of the ships that traveled across the Atlantic carried the naturalists. So I see myself as a naturalist, which is what I've always aspired to be. I see Michael, also, as one of those naturalists, one of those people whom I would like to think is writing on the very technological transformation of that revolution—just as I think, Darwin, much later, was writing on the very technological vehicle that had created his revolution. I think we are here, riding on that technological package of transgenic manipulation and change, and we have this great opportunity to be naturalists in that revolution.

Those ships also usually had a narrator, somebody who would narrate what was happening—a historian we call them today, but at that time it was someone more like Michael, someone who was just very curious about the behavior of those people who were performing that revolution—who were actually riding those ships. And I see Michael very much as that, but I see all of us thinkers, whatever the discipline or the field that you are in, as those narrators, or at least people who have that opportunity to narrate, to leave some kind of history of what happened for the future to, hopefully, get a handle on these transformations, these major transformations. Because up to this point we have been riding this transformation in this revolution pretty much with closed eyes, with very few

exceptions: people like Michael, who have the capacity and have the willingness to take on someone like Monsanto and write about what's happening, not for, not against, but simply narrate what's happening.

We also have the opportunity—and I think that's a much more political statement—to try to think and to decide who is riding that technology, who is riding that ship, and where that ship is going. Just as some of those narrators back during colonial times had some impact on how those technological gizmos, those ships, worked for technologies and so on, I think we do have an opportunity today, as narrators and thinkers, to make decisions, to drive this business of biotech, those technological gizmos of biotechnology.

So I would like to invite you to recognize in the simple, beautiful writing that Michael does, an incredibly important historical task. Whatever it is that you do and we do—I as a scientist, you as whatever you are—we have the opportunity to take control, the opportunity to at least recognize and realize that we are doing this, and the great responsibility we have towards, in this case, not only other humans that look a little bit different from us, but all the other species that are not us, and the future generations of those species and of humans.

Commentary

Patricia Unterman

Well, I have the honor of being last and trying to pull very huge and interesting ideas together. I'm afraid I can only do it in the microcosm, because I took this opportunity to think about ecology in terms of my restaurant, The Hayes Street Grill, and the morality of that, of what that means day-to-day on the front lines. Every day, I think about exactly the problems that Michael has talked about, which is balancing the needs of my business versus the needs of keeping the planet alive. The scale is very tiny, and I'm trying to do the best I can. So I took this opportunity to think about it and write this little piece, which I guess I'm going to read. I didn't know which way to go in this thing.

But, at any rate, as a restaurant owner, I'm concerned about the health and sustainability of food sources, and I am very deeply involved with the issues of food, in general. And, of course, food has three basic functions as far as I'm concerned. On the basic level, it's fuel. Secondly, it's pleasure, and possibly entertainment. And, of course, most recently, and maybe forever, foods become a statement about moral decision. And this role of balancing all these has changed considerably over the twenty years I've been running a restaurant in San Francisco.

Now, some of this history illustrates the conflicts and dilemmas of a moral nature which face everyone who eats. But people in the business of feeding others have a heightened consciousness about these moral implications. We all know—every one of us knows—the choices and the impact of the choices that every individual faces when he buys food in the supermarket, or at the farmer's market,

or at an expensive restaurant, or at a cheap restaurant. I mean, just think about this process, for the moment, of choosing your food.

Now think about a restaurant owner who's making the decisions for the customer, on the customer's behalf, in effect, with a moral imperative from the customer. By choosing to eat at my place, the customer is tacitly endorsing the moral decision-making of the owner. The owner has to be conscious of the role of both providing moral leadership and providing the kind of moral leadership that the customer will subscribe to so that the owner can stay in business.

I first opened my restaurant with an aesthetic idea about freshness. I was lounging on the Dalmatian Coast with my current partner, eating grilled fish pulled directly from the then pristine Adriatic, and thinking that this kind of cookery would work very well in San Francisco. In fact, the owners of one of the city's oldest and most popular restaurants, the Tadich Grill, came from this coast, and were grilling fish much the same way. But freshness was not their top priority. They did whatever it took to put out what was written on their menu every day, whether, you know, they had to use fresh, frozen, or canned ingredients. I wanted to take this concept of the traditional San Francisco grill a step further, or maybe backwards to its roots, and cook only with fresh food. Right off the bat, I was faced with the dilemma of not having enough food to offer. This was in 1979. I wanted to do, basically, a fish restaurant. So way back then, we only used a blackboard to list all of our fish, and sometimes we could only find two or three fresh fish to serve. There was plenty of frozen seafood available, but we couldn't serve it because I didn't think it tasted as good as that grilled fish I had in Europe. People would stream in on their way to the Opera House—Davies Hall wasn't built then—and look at the blackboard and shake their heads. "Is this all you have tonight?" they'd ask.

Then, on top of this, I insisted that the fish be undercooked by then-current standards. I thought that if the fish was fresh, it didn't need to be cooked to death and lose its texture and flavor as it does when you overcook it. Many a plate of salmon was sent back to be refired. And the waiters began telling people to ask for their fish well-done, just to get them out on time. We adjusted to the customers and the customers adjusted to us. But when I think back about that time, I really am embarrassed because I was so doctrinaire about the way I thought

it should be done. I wanted to teach people how good fish could be if it were cooked right.

Luckily, the people kept coming back. There weren't many other places to eat in the neighborhood, and they must have been convinced. On our part, we started finding more fresh fish to prepare. Our fish purveyor, Paul Johnson, a friend, who started his business because we started running a fish restaurant, mainly looked for the prettiest fish for us, no matter where it came from or how it was caught. And both of us started realizing, as we doubled our restaurant in size, and he started selling more and more fish to different restaurants, that certain fish had been very much in demand, that these fish, like red snapper, or dungeness crabs, or Atlantic cod, were getting harder and harder to find. But we didn't think too much about it, and we just moved on to the next fish that came onto the market that was fresh and pretty, and cooked up nicely. We didn't think about this.

Then, in about 1985, we had the parasite scare. Local fish from the Bay were ingesting parasites from the wastes of all the sea lions that were multiplying uncontrollably in the Bay. Fisherman traditionally used to kill them, but now conservationists insist on protecting the seals and sea lions. As attractive as these monsters were to the tourists, they were ruining the local fish supply. The press reported that you had to cook fish well-done to be safe. So I faced another dilemma: health versus aesthetics. I got a parasitologist from UCSF to test the fish for parasites at different temperatures. We figured out exactly how little I could cook the fish and still be safe. But we had to convince the waiters—who had to convince the diners, who knew all along that there was a reason why you had to eat fish well-done—that we were cooking the fish the right way.

Today, I wish that were my worst problem. Now, everyone is fearless about eating raw fish. People love ceviche and carpaccio and tartar, and it's not a problem. Undercooking is no longer an issue. So I won that aesthetic battle. But every morning these days, I have a surrealistic conversation with my fish man about what I morally can serve in the restaurant. We all agreed that local fish are the best choice. But there happens to a be Pacific Coast fishing moratorium that extends from Baja to the Canadian border, in order to protect endangered rock fish, which used to be very cheap and plentiful. You know, red snapper, it was on the menu, and it is now facing extinction. What this means is that the local sand dab and petrali fisheries have been shut down, even though the small boats out of

Half Moon Bay that we use in San Francisco have absolutely no by-catch of these endangered rockfish. These boats should be allowed to go out, but the federal regulators don't have the manpower to certify that they're catching cleanly, and dabs and petrali are the mainstay of our San Francisco grill. And so many other fish have dropped off our "okay" list such that I sort of fear that the whole thing is going to come full circle. Soon I'm going to have a blackboard with two fish on it. It's really, really an issue.

I'm going to give you an example. We can't serve, now, the delicious, satiny Chilean sea bass, because they're facing extinction from pirating near Antarctica—besides which I happen to be a personal spokesperson for their boycott. I will not serve farmed salmon, because I've been convinced that high intensity fish farming pollutes the ocean. So, of course, I had to take all the smoked salmon off the menu because all the smokers, large or small, use only farm salmon for size conformity, cleanliness—there are no parasites because they feed them antibiotics—and texture. Now the farm salmon issue encapsulates the crux of the moral dilemma that a little guy like me faces. Eighty percent of the customers who walk in to the fish restaurant, want to eat salmon. And I take it off the menu when I can't get it wild.

Now what does this mean? What if customers stop coming because they can't get salmon? Sixty-eight people that I employ depend on my restaurant for their livelihood. Should I put their well-being at risk? Maybe I should put farm salmon on the menu, label it as such, and let the customer make the decision? That's advocated by my husband. But I feel I can't do this, because when I buy the farm product, I'm endorsing it. Whereas if I and every other restaurant stops buying it, there's a chance that the farming practices might become more sustainable.

I started the restaurant making choices for people. I just wanted to tell people what was good, and what's bad, and I can't stop now. So my fish man and I debate the morality of every item on the menu—the trade-offs, the compromises, the lesser of evils. Scallops, for example, are very plentiful. The fisheries off Maine and Rhode Island are strong, but the technique of collecting the scallops off the bottom of the ocean destroys habitat. We're all hoping for a solution. I still sell them.

And just recently—here's the latest—a doctor in Marin reported that 89 of 116 of her "affluent patients" who reported symptoms of fatigue, aching joints, and memory loss had elevated mercury levels in their blood, and happen to eat fish more than two times a week. So there was a mercury scare. Paul Johnson, my fish man, and I batted that around. We consulted an FDA list and discovered that the only fish that we actually dealt with that had a mercury standard above the USDA level was swordfish. And, actually, I'm not sure that the smaller Pacific swordfish that we're getting from Southern California actually have a higher level of mercury. But they are smaller fish, which is a warning flag that they might be over-fished. And as a conscientious restaurateur and public spokesperson for ocean conservation and sustainable fishing, I sometimes feel like I'm in a squirrel cage. How do I reconcile putting the tastiest food on the table, which is why I started the restaurant, with treading lightly on the planet?

So I started the restaurant as a cultural/aesthetic statement about food, and I'm fighting on as a moral arbiter about what's okay to eat and what's not, and trying to find some balance between food as fuel, and pleasure, and moral decision. Our waiters used to say, "Bon appetit," as they set their plates down on the table, which I think relates to the idea of "food is fuel." It's the satisfaction of hunger. Then they went through a stage of saying, "Enjoy." I told them not to say this, but they said it. And this, of course, is a message about pleasure. And now, waiters all over America say, "Good choice." Now, what they probably are meaning to do is compliment the customer on how sophisticated his or her choice is, you know, that they've chosen the tastiest things on the menu. But the current usage also reflects how important choice has become as a moral imperative in public consumption.

Moral choice has become intrinsic to the dinner table—which is what Michael has been writing about. In fact, the restaurant these days is a representation of the culture of morality, a culture that's become so prominent here in Berkeley and in the Bay Area, you know, it's a battle, almost. Morality infuses the very language of the menu. A menu may proudly list, for example, "Maraquito Farm Heirloom tomatoes," and, actually, mine does. But no menu can explain what this description, what this language, means. So here's the backstory. I buy these tomatoes directly from the farmer at the Ferry Plaza Farmer's Market. And I happened to know that these tomatoes are raised organically, but they do not

qualify for the new federal organic label, because the farmer has decided he's beyond organic. And he purposely wants to raise the question of what is more important, organic or local, small farm versus big? And, after a lot of soul searching, I've decided I personally support local and small over certified organic and large.

But, as we know, that's a whole other story. Only those deep into buying locally can read a menu and know where a restaurant stands on this issue, or—I'm going to give you one last example and then wrap it up—a menu may list something like "turtle-free North Carolina shrimp." This means that the shrimp are wild, but caught with special nets that allow endangered sea turtles to escape. I happen to believe that wild shrimp caught sustainably is preferable to most kinds of shrimp from farms, which are notorious for destroying coastal wetlands and precious spawning grounds. This menu description of two fragments of dishes, tomatoes and shrimp, are indicative of a layered moral narrative that's caused well-meaning restaurateurs like me a lot of lost sleep.

We only thought we were in the business of giving people pleasure. We didn't know we'd end up being moral arbiters, and that the restaurant would become a battleground, an educational tool, and a political platform about the morality of eating.

Audience Comments
on the Panel Discussion

MICHAEL POLLAN: I'm very provoked by everything I've heard. Patricia should publish that piece. It's wonderful. I think it points to something very interesting, which is that the chef has a social role in our society. I mean, has there ever been a time—maybe you can answer this, I don't know—where chefs have become educators, moral arbiters, and actual forces for change? What is going on in the fisheries around this country, and, certainly, in the East Coast, has been driven by chefs organizing to save the swordfish or save the cod, or anything like that. And that's an astonishing development, I think, and very hopeful one.

And I think Ignacio's metaphor of the Colombian Exchange is a very powerful one. I'd never thought about what's going on with genetic engineering in that way. It's a metaphor I want to play with. As a journalist, you think your concerns are incredibly contemporary, and it's always very chastening to learn that they're incredibly old. But we have to pretend otherwise, to go on writing for journals. So I just have so much to think about. I'm busy writing notes. I'm very grateful for these presentations.

COMMENT: Frank Norris' fiction, *The Pit*, for example, reminds me that one hundred years ago somebody was thinking of issues of the relationship of industrial economy to food. Can you relate that to your article on the steer? Also, did you end up eating the steer?

MICHAEL POLLAN: I didn't end up eating it. I had hoped to. I published the article before the steer was slaughtered. I published it, I think, on April 1 and the slaughter date wasn't until June. The original plan was that the packing plant was

going to pull a box of meat out of the supply and send it me, but they were very displeased with the article and decided not to be helpful, and didn't want me writing anything else about them. So I didn't get to eat it.

In a way it didn't matter because this was commodity beef and it was no different from any other beef of the same grade—certified Angus. And what ultimately happened was kind of odd. I knew that the animal was to be slaughtered in mid-June. At that point, they weren't going to let me watch or have anything to do with that. And I found myself in Atlanta on the fourtheenth of June, on a book tour. I decided that probably the next day was going to be his day. I happened to be staying at a hotel where the restaurant was The Palm, the offshoot of the New York steakhouse. So I thought, "Well, this is kind of meant to be. I'm going to have a rib eye steak at The Palm in honor of my steer, #534." And I brought my copy of Peter Singer's *Animal Liberation*, because I'd also decided at that point, that I wanted to write about animal rights. Then the next day, something kind of spooky happened. I was flying from Atlanta to Denver. It was a flight with a pilot who wasn't chatty—he didn't tell us our route or altitude or anything like that. But about three hours into the flight, he comes on the intercom for only the second time and says, "We're flying over Liberal, Kansas," which happens to be the town where the slaughter house is. And then he mentions no other place. It was just a very, very eerie moment for me, and convinced me I should write about animal rights, and quick.

COMMENT: Given this tendency toward homogeneity and industrial processing, what do you think that a food system would be like if it were sustainable in some esoteric or hypothetical sense? Can we conceive of, or better yet, create a de-industrialized food system, and if so, would anyone want it?

PATRICIA UNTERMAN: You know, I've often thought about that question. I was interviewing this farmer named Rick Knoll, who's a biodynamic farmer up here in Brentwood, California. He has a big production. I mean that he produces something like $40,000 worth of produce off of each of his acres a season. He's a real advocate for this biodynamic farming. And I said, "Well, you can't feed the world this way, can you?" He said that if everyone practiced his method of biodynamic farming, if you took the Los Angeles Basin and turned it over to

agriculture, and his method of biodynamic farming was practiced there, he could feed the whole country. He said it was absolutely possible.

MICHAEL POLLAN: You know, it's a real hard issue whether sustainable agriculture can feed the world. I don't know the answer. I do know a couple of things. Industrial agriculture is not now feeding the world. There are enormous issues of equity and distribution. There is plenty of food that's grown—there's enough being grown to feed the world—but it's concentrated in the hands of the people who have the money. Whether there is enough food is not the issue: it's who commands it.

The other thing is this idea that we should be moving toward a single food chain, and that we need the one model that's going to do it. That is industrial thinking right there, that belief that there is only one solution—that we have this one kind of agriculture, it can even be organic or IPM (integrated pest management) or industrial. I think here, too, we have to look at the logic of natural systems, which is that you don't put all your eggs in one basket. We need a lot of different food chains. We need a sustainable food chain. We need an organic food chain. We need a beyond-organic food chain. We need them all for many reasons. We need to test different solutions. You know, you need to experiment and find out what works. And, also, some are going to cost more than others. There are enormous issues of equity and elitism. Sustainable agriculture as it is now practiced, for all sorts of complicated reasons, produces more expensive food. One reason is that it is not subsidized. That's huge. I mean, the industrial food system, as we know, is subsidized to an incredible extent; and organic, not at all. So I think that this is a question that's always posed by conventional food system: can alternatives feed the world? And I think it's very much the question embedded in an industrial mindset, and that mindset is part of the problem.

IGNACIO CHAPELA: I totally agree with Michael that the trend towards regionalization and specificity for place is really important. I just wanted to add that when you talk about subsidization, I think it's important to remember that there is the monetary way of subsidizing things. There's also the ecological way of subsidizing things, which is often taken totally off the books. You know, we're undermining water, we're undermining soils, we are undermining the oceans'

ability to deal with the by-products of industrial agriculture and so on. These are things that over a long enough periods of time are coming back to haunt us. We should account for these things, too.

CATHERINE GALLAGHER: I have nothing to say on this topic at all. But these are the answers I came here to listen to.

COMMENT: Do you see any positive direction for bioengineering?

IGNACIO CHAPELA: Do I see anything positive about bioengineering? I think bioengineering is an incredibly powerful and potentially very useful set of methods and technologies, and so on and so forth. I think I do agree with you, Michael, on the specific history of the deployment of specifically transgenic organisms in the environment. It makes me feel wary about the transgenic organisms let loose in the environment right now, because of this history, because of how it happened. So no, I do not see anything really good coming out of it, not in the next couple of decades.

But there are lots of things that can be done in the lab. There are lots of things that can be more or less contained. I really hesitate to endorse it. But I would never advocate the moral position of saying, "Well, let's not look there," because I think there are great things to be done and to be, at least, learned. For research, for example, genetic engineering is an incredible tool, you know, an eye-opening tool. There is an industrial agricultural mindset at the turn of the twenty-first century, where we are driven by an industrial complex that is a descendant of the great, huge corporations with massive global reach, with strong muscles in government and so on. And the venture capital companies run on promises that they know they cannot fulfill, but they just float them because nobody understands what they're talking about. They used to run on red money all the time, and who cares, you know, "We'll just cash in our stock and move on." The whole historical development of how we got into it, I think, has incredible potential for damage.

MICHAEL POLLAN: You know, the promise of biotechnology is a very seductive thing. And we hear about some wonderful things that can be done with

this. We've heard about Golden Rice, which is rice that has more beta carotene in it, which can help people with nutritional deficiencies; plants that can grow in salt conditions; plants that need less water. And they're asking us to judge the technology—the industry asks us to judge the technology—on the basis of these promises. But, really, what this technology is about so far—even though it's sold as more sustainable and a way to get us past chemicals—has been a way to sell a lot more herbicide. We've been into this now for six, seven years, and most of the transgenic crops are Round-Up (a chemical fertilizer) ready crops, which allow you to just shower your field with herbicide produced by the same company, Monsanto, that produces the plant. So that's what we're really doing with it.

Could we be doing other things with it and might they be good? Yes, I think so. Although, the more you look at some of these great promises, the more they retreat on the horizon. It turns out to be a lot harder to do good things. For instance, it always struck me as a wonderful idea if you could get plants to fix their own nitrogen in the way that legumes do. They wouldn't need as much nitrogen fertilizer because they can actually take it from the air. It's this wonderful trick that plants have mastered. But we're nowhere near mastering that trick ourselves. And, apparently, that promise, which was held up as one of the things this technology was going to do, is so far away they don't even talk about it anymore. So all the interesting things involve many, many genes and very complex cassettes of genes that you would have to move in, and they're just not near doing it.

So be wary when you're asked to accept this technology now in order to make real a possibility that may or may not be reached in the future.

COMMENT: You once said that other people don't eat the way we do in Berkeley. Can the consumer drive this process?

PATRICIA UNTERMAN: Well, the consumer has enormous power to change the food system. I've seen that just on these fish boycotts, where public interest PR firms would start a boycott of Atlantic swordfish. And, in fact, statistically, Atlantic swordfish stopped being ordered, and it helped bring back the fishery and it really works. I think there is enormous potential for consumer consciousness-raising and then consumer action. I think it's actually where it all has to be.

MICHAEL POLLAN: I agree. To identify ourselves as consumers has always struck me as kind of a pathetic identity. And we've all learned about how small that is. But it doesn't have to be that. I mean, consumers are creators, also, and with their decisions can produce changes in the world. You can approach your consumption decisions in a very narrow, self-interested way to just get what satisfies your own needs or desires, or you can approach it the way Patricia is talking about. We've been encouraged in this society to separate our identity as consumers from our identity as citizens, but, of course, we don't have to do that. We can consume as citizens, we can consume with a larger sense of what our interests are, or our collective interests, or the interests of other species.

And people are starting to do that. I mean, that's what the organic label is all about. Yes, a lot of people buy organic because they believe it's healthier, which it may or may not be. But many people also buy organic because they're voting for a certain kind of agriculture. And it's worked. It's been an enormous success, and it's becoming a very big business. So I actually think that the emergence of that model of consumption is bigger than food. I find that incredibly hopeful.

But people don't eat the way they do in Berkeley. I mean, there's definitely a higher consciousness about these issues here. But it's definitely spreading also.

The other side, the other power of the consumer that I've had some direct experience with that is worth bearing in mind is that food companies are uniquely vulnerable, I think, to any kind of action on the part of consumers. They're very sensitive. Food is tied up with our health, with our very life, so food companies get scared very quickly.

What happened with the new leaf potato that I started out talking about a while ago, is that it's off the market now. It has failed as a product. How did it fail? Well, it's kind of an interesting story. There was a line in my article saying, "By the way, you know, you think this is way out there, but in fact, if you've been to McDonald's in the last year, you have eaten genetically modified potatoes. And if you've bought a Frito-Lay potato chip, you have eaten genetically modified potato." That sort of got around, and a certain number of consumers, probably quite small, started calling McDonald's saying, "Is it true you serve genetically modified potatoes?" Now, I've been told that McDonald's has stopped using that potato.

Contributing writer to the *New York Times Magazine*, Michael Pollan has done a range of work in journalism, environmentalism, and architecture. Pollan earned his college degrees at Bennington College, Oxford University (Mansfield College), and Columbia University, where he received a masters in English in 1981. He served for many years as executive editor for *Harper's* magazine.

Pollan's first book, *Second Nature: A Gardener's Education* (1991), and his most recent, *The Botany of Desire* (2001), are among his many works that examine the intersections between science and culture. Pollan has given lectures on environmentalism, gardening, and nature at the Cooper-Hewitt Museum, the New York Public Library, the Harvard Graduate School of Design, and the New York Botanical Garden.

Ignacio Chapela is Assistant Professor of Microbial Ecology in the Department of Environmental Science, Policy and Management at Berkeley. He is also the founder of The Mycological Facility, a facility dealing with questions of natural resources and indigenous rights, based in and run by indigenous communities in Oaxaca, Mexico. His publications include academic work and various media collaborations with journalists worldwide, including documentaries and news media. Chapela has worked for the pharmaceutical/agrochemical industry as a scientific researcher, as well as with the Agricultural Research Service of the USDA. He is currently on the Board of Directors of the Pesticide Action Network, an international civic group dedicated to the promotion of alternatives to the use of pesticides.

Catherine Gallagher is Eggers Professor of English Literature at the University of California at Berkeley, where she has taught since 1980. Her books include *The Industrial Reformation of English Fiction: Social Discourse and Narrative Form, 1832-67* (1985), *Nobody's Story: The Vanishing Acts of Women Writers in the Literary Marketplace* (1994) (winner of the Modem Language Association's James Russell Lowell Prize for the best critical book of the year), and (with Stephen Greenblatt) *Practicing New Historicism* (2000).

Gallagher has received NEH and Guggenheim fellowships. She is a member of the editorial board of the journal *Representations;* other

editorial projects include co-editorship of the book series Cambridge Studies in Nineteenth-Century Literature & Culture and *The Making of the Modern Body: Sexuality and Society in the Nineteenth Century*.

PATRICIA UNTERMAN has been a restaurant critic, chef, and food writer in San Francisco for over thirty years. She currently writes restaurant reviews and food columns for the *San Francisco Examiner* as well as articles for *Gourmet, Food and Wine,* and *Bon Appetit*. She is author of *Patricia Unterman's San Francisco Food Lovers' Guide*, currently in its third edition.

Unterman is chef and co-owner of the Hayes Street Grill in San Francisco. The restaurant specializes in grilled fish and local, seasonal foods, much of it purchased directly from farmers and producers. She also publishes *Unterman on Food*, a bi-monthly newsletter on food, wine, dining, and travel.