

found that a dollar could buy 1,200 calories of potato chips and cookies; spent on a whole food like carrots, the same dollar buys only 250 calories. On the beverage aisle, you can buy 875 calories of soda for a dollar, or 170 calories of fruit juice from concentrate. It makes good economic sense that people with limited money to spend on food would spend it on the cheapest calories they can find, especially when the cheapest calories—fats and sugars—are precisely the ones offering the biggest neurobiological rewards.

Corn is not the only source of cheap energy in the supermarket—much of the fat added to processed foods comes from soybeans—but it is by far the most important. As George Naylor said, growing corn is the most efficient way to get energy—calories—from an acre of Iowa farmland. That corn-made calorie can find its way into our bodies in the form of an animal fat, a sugar, or a starch, such is the protean nature of the carbon in that big kernel. But as productive and protean as the corn plant is, finally it is a set of human choices that have made these molecules quite as cheap as they have become: a quarter century of farm policies designed to encourage the overproduction of this crop and hardly any other. Very simply, we subsidize high-fructose corn syrup in this country, but not carrots. While the surgeon general is raising alarms over the epidemic of obesity, the president is signing farm bills designed to keep the river of cheap corn flowing, guaranteeing that the cheapest calories in the supermarket will continue to be the unhealthiest.

SEVEN

THE MEAL

Fast Food

The meal at the end of the industrial food chain that begins in an Iowa cornfield is prepared by McDonald's and eaten in a moving car. Or at least this was the version of the industrial meal I chose to eat; it could easily have been another. The myriad streams of commodity corn, after being variously processed and turned into meat, converge in all sorts of different meals I might have eaten, at KFC or Pizza Hut or Applebee's, or prepared myself from ingredients bought at the supermarket. Industrial meals are all around us, after all; they make up the food chain from which most of us eat most of the time.

My eleven-year-old son, Isaac, was more than happy to join me at McDonald's; he doesn't get there often, so it's a treat. (For most American children today, it is no longer such a treat: One in three of them eat fast food every single day.) Judith, my wife, was less enthusiastic. She's careful about what she eats, and having a fast-food lunch meant giving up a "real meal," which seemed a shame. Isaac pointed out that she could order one of McDonald's new "premium salads" with the Paul Newman dressing. I read in the business pages that these salads are a big

McDonald's meals

Isaac's

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hit, but even if they weren't, they'd probably stay on the menu strictly for their rhetorical usefulness. The marketers have a term for what a salad or veggie burger does for a fast-food chain: "denying the denier." These healthier menu items hand the child who wants to eat fast food a sharp tool with which to chip away at his parents' objections. "But Mom, you can get the salad . . ."

Which is exactly what Judith did: order the Cobb salad with Caesar dressing. At \$3.99, it was the most expensive item on the menu. I ordered a classic cheeseburger, large fries, and a large Coke. Large turns out to be a full 32 ounces (a quart of soda!) but, thanks to the magical economics of supersizing, it cost only 30 cents more than the 16-ounce "small." Isaac went with the new white-meat Chicken McNuggets, a double-thick vanilla shake, and a large order of fries, followed by a new dessert treat consisting of freeze-dried pellets of ice cream. That each of us ordered something different is a hallmark of the industrial food chain, which breaks the family down into its various demographics and markets separately to each one: Together we would be eating alone together, and therefore probably eating more. The total for the three of us came to fourteen dollars, and was packed up and ready to go in four minutes. Before I left the register I picked up a densely printed handout called "A Full Serving of Nutrition Facts: Choose the Best Meal for You."

We could have slipped into a booth, but it was such a nice day we decided to put the top down on the convertible and eat our lunch in the car, something the food and the car have both been engineered to accommodate. These days 19 percent of American meals are eaten in the car. The car has cup holders, front seat and rear, and, except for the salad, all the food (which we could have ordered, paid for, and picked up without opening the car door) can be readily eaten with one hand. Indeed, this is the genius of the chicken nugget: It liberated chicken from the fork and plate, making it as convenient, waste-free, and automobile-friendly as the precondimented hamburger. No doubt the food scientists at McDonald's corporate headquarters in Oak Brook, Illinois, are right now hard at work on the one-handed salad.

But though Judith's Cobb salad did present a challenge to front-seat

dining, eating it at fifty-five miles per hour seemed like the thing to do, since corn was the theme of this meal. The car was eating corn too, being fueled in part by ethanol. Even though the additive promises to diminish air quality in California, new federal mandates pushed by the corn processors require refineries in the state to help eat the corn surplus by diluting their gasoline with 10 percent ethanol.

I ate a lot of McDonald's as a kid. This was in the pre-Wallerstein era, when you still had to order a second little burger or sack of fries if you wanted more, and the chicken nugget had not yet been invented. (One memorable childhood McDonald's meal ended when our station wagon got rear-ended at a light, propelling my milk shake across the car in creamy white lariats.) I loved everything about fast food: the individual portions all wrapped up like presents (not having to share with my three sisters was a big part of the appeal; fast food was private property at its best); the familiar meaty perfume of the French fries filling the car; and the pleasingly sequenced bite into a burger—the soft, sweet roll, the crunchy pickle, the savory moistness of the meat.

Well-designed fast food has a fragrance and flavor all its own, a fragrance and flavor only nominally connected to hamburgers or French fries or for that matter to any particular food. Certainly the hamburgers and fries you make at home don't have it. And yet Chicken McNuggets do, even though they're ostensibly an entirely different food made from a different species. Whatever it is (surely the food scientists know), for countless millions of people living now, this generic fast-food flavor is one of the unerasable smells and tastes of childhood—which makes it a kind of comfort food. Like other comfort foods, it supplies (besides nostalgia) a jolt of carbohydrates and fat, which, some scientists now believe, relieve stress and bathe the brain in chemicals that make it feel good.

Isaac announced that his white-meat McNuggets were tasty, a definite improvement over the old recipe. McNuggets have come in for a lot of criticism recently, which might explain the reformulation. Ruling in 2003 in a lawsuit brought against McDonald's by a group of obese teenagers, a federal judge in New York had defamed the McNugget even

as he dismissed the suit. "Rather than being merely chicken fried in a pan," he wrote in his decision, McNuggets "are a McFrankensteinian creation of various elements not utilized by the home cook." After cataloging the thirty-eight ingredients in a McNugget, Judge Sweet suggested that McDonald's marketing bordered on deceptive, since the dish is not what it purports to be—that is, a piece of chicken simply fried—and, contrary to what a consumer might reasonably expect, actually contains more fat and total calories than a cheeseburger. Since the lawsuit, McDonald's has reformulated the nugget with white meat, and begun handing out "A Full Serving of Nutrition Facts."^{*} According to the flyer, a serving of six nuggets now has precisely ten fewer calories than a cheeseburger. Chalk up another achievement for food science.

When I asked Isaac if the new nuggets tasted more like chicken than the old ones, he seemed baffled by the question. "No, they taste like what they are, which is nuggets," and then dropped on his dad a withering two-syllable "duh." In this consumer's mind at least, the link between a nugget and the chicken in it was never more than notional, and probably irrelevant. By now the nugget constitutes its own genre of food for American children, many of whom eat nuggets every day. For Isaac, the nugget is a distinct taste of childhood, quite apart from chicken, and no doubt a future vehicle of nostalgia—a madeleine in the making.

Isaac passed one up to the front for Judith and me to sample. It looked and smelled pretty good, with a nice crust and bright white interior reminiscent of chicken breast meat. In appearance and texture a nugget certainly alludes to fried chicken, yet all I could really taste was salt, that all-purpose fast-food flavor, and, okay, maybe a note of chicken bouillon informing the salt. Overall the nugget seemed more like an abstraction than a full-fledged food, an idea of chicken waiting to be fleshed out.

The ingredients listed in the flyer suggest a lot of thought goes into a nugget, that and a lot of corn. Of the thirty-eight ingredients it takes

^{*}In 2005 McDonald's announced it would begin printing nutrition information on its packaging

to make a McNugget, I counted thirteen that can be derived from corn: the corn-fed chicken itself; modified cornstarch (to bind the pulverized chicken meat); mono-, tri-, and diglycerides (emulsifiers, which keep the fats and water from separating); dextrose; lecithin (another emulsifier); chicken broth (to restore some of the flavor that processing leaches out); yellow corn flour and more modified cornstarch (for the batter); cornstarch (a filler); vegetable shortening; partially hydrogenated corn oil; and citric acid as a preservative. A couple of other plants take part in the nugget: There's some wheat in the batter, and on any given day the hydrogenated oil could come from soybeans, canola, or cotton rather than corn, depending on market price and availability.

According to the handout, McNuggets also contain several completely synthetic ingredients, quasi-edible substances that ultimately come not from a corn or soybean field but from a petroleum refinery or chemical plant. These chemicals are what make modern processed foods possible, by keeping the organic materials in them from going bad or looking strange after months in the freezer or on the road. Listed first are the "leavening agents": sodium aluminum phosphate, monocalcium phosphate, sodium acid pyrophosphate, and calcium lactate. These are antioxidants added to keep the various animal and vegetable fats involved in a nugget from turning rancid. Then there are "anti-foaming agents" like dimethylpolysiloxane, added to the cooking oil to keep the starches from binding to air molecules, so as to produce foam during the fry. The problem is evidently grave enough to warrant adding a toxic chemical to the food: According to the Handbook of Food Additives, dimethylpolysiloxane is a suspected carcinogen and an established mutagen, tumorigen, and reproductive effector; it's also flammable. But perhaps the most alarming ingredient in a Chicken McNugget is tertiary butylhydroquinone, or TBHQ, an antioxidant derived from petroleum that is either sprayed directly on the nugget or the inside of the box it comes in to "help preserve freshness." According to a Consumer's Dictionary of Food Additives, TBHQ is a form of butane (i.e., lighter fluid) the FDA allows processors to use sparingly in our food: It can

comprise no more than 0.02 percent of the oil in a nugget. Which is probably just as well, considering that ingesting a single gram of TBHQ can cause "nausea, vomiting, ringing in the ears, delirium, a sense of suffocation, and collapse." Ingesting five grams of TBHQ can kill.

With so many exotic molecules organized into a food of such complexity, you would almost expect a chicken nugget to do something more spectacular than taste okay to a child and fill him up inexpensively. What it has done, of course, is to sell an awful lot of chicken for companies like Tyson, which invented the nugget—at McDonald's behest—in 1983. The nugget is the reason chicken has supplanted beef as the most popular meat in America.

Compared to Isaac's nuggets, my cheeseburger is a fairly simple construct. According to "A Full Serving of Nutrition Facts," the cheeseburger contains a mere six ingredients, all but one of them familiar: a 100 percent beef patty, a bun, two American cheese slices, ketchup, mustard, pickles, onions, and "grill seasoning," whatever that is. It tasted pretty good, too, though on reflection what I mainly tasted were the condiments: Sampled by itself, the gray patty had hardly any flavor. And yet the whole package, especially on first bite, did manage to give off a fairly convincing burgerish aura. I suspect, however, that owes more to the olfactory brilliance of the "grill seasoning" than to the 100 percent beef patty.

In truth, my cheeseburger's relationship to beef seemed nearly as metaphorical as the nugget's relationship to a chicken. Eating it, I had to remind myself that there was an actual cow involved in this meal—most likely a burned-out old dairy cow (the source of most fast-food beef) but possibly bits and pieces of a steer like 534 as well. Part of the appeal of hamburgers and nuggets is that their boneless abstractions allow us to forget we're eating animals. I'd been on the feedlot in Garden City only a few months earlier, yet this experience of cattle was so far removed from that one as to be taking place in a different dimension. No, I could not taste the feed corn or the petroleum or the antibiotics or the hormones—or the feedlot manure. Yet while "A Full Serving of Nutrition Facts" did not enumerate these facts, they too have gone into

the making of this hamburger, are part of its natural history. That perhaps is what the industrial food chain does best: obscure the histories of the foods it produces by processing them to such an extent that they appear as pure products of culture rather than nature—things made from plants and animals. Despite the blizzard of information contained in the helpful McDonald's flyer—the thousands of words and numbers specifying ingredients and portion sizes, calories and nutrients—all this food remains perfectly opaque. Where does it come from? It comes from McDonald's.

But that's not so. It comes from refrigerated trucks and from warehouses, from slaughterhouses, from factory farms in towns like Garden City, Kansas, from ranches in Sturgis, South Dakota, from food science laboratories in Oak Brook, Illinois, from flavor companies on the New Jersey Turnpike, from petroleum refineries, from processing plants owned by ADM and Cargill, from grain elevators in towns like Farmville, and, at the end of that long and tortuous trail, from a field of corn and soybeans farmed by George Naylor in Churdan, Iowa.

It would not be impossible to calculate exactly how much corn Judith, Isaac, and I consumed in our McDonald's meal. I figure my 4-ounce burger, for instance, represents nearly 2 pounds of corn (based on a cow's feed conversion rate of 7 pounds of corn for every 1 pound of gain, half of which is edible meat). The nuggets are a little harder to translate into corn, since there's no telling how much actual chicken goes into a nugget; but if 6 nuggets contain a quarter pound of meat, that would have taken a chicken half a pound of feed corn to grow. A 32-ounce soda contains 86 grams of high-fructose corn syrup (as does a double-thick shake), which can be refined from a third of a pound of corn; so our 3 drinks used another 1 pound. Subtotal: 6 pounds of corn.

From here the calculations become trickier because, according to the ingredients list in the flyer, corn is everywhere in our meal, but in unspecified amounts. There's more corn sweetener in my cheeseburger, of all places: The bun and the ketchup both contain HFCS. It's in the salad dressing, too, and the sauces for the nuggets, not to mention Isaac's dessert. (Of the sixty menu items listed in the handout, forty-

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five contain HFCS.) Then there are all the other corn ingredients in the nugget: the binders and emulsifiers and fillers. In addition to corn sweeteners, Isaac's shake contains corn syrup solids, mono- and diglycerides, and milk from corn-fed animals. Judith's Cobb salad is also stuffed with corn, even though there's not a kernel in it: Paul Newman makes his dressing with HFCS, corn syrup, corn starch, dextrin, carmel color, and xanthan gum; the salad itself contains cheese and eggs from corn-fed animals. The salad's grilled chicken breast is injected with a "flavor solution" that contains maltodextrin, dextrose, and monosodium glutamate. Sure, there are a lot of leafy greens in Judith's salad too, but the overwhelming majority of the calories in it (and there are 500 of them, when you count the dressing) ultimately come from corn. And the French fries? You would think those are mostly potatoes. Yet since half of the 540 calories in a large order of fries come from the oil they're fried in, the ultimate source of these calories is not a potato farm but a field of corn or soybeans.

The calculation finally defeated me, but I took it far enough to estimate that, if you include the corn in the gas tank (a whole bushel right there, to make two and a half gallons of ethanol), the amount of corn that went into producing our movable fast-food feast would easily have overflowed the car's trunk, spilling a trail of golden kernels on the blacktop behind us.

Some time later I found another way to calculate just how much corn we had eaten that day. I asked Todd Dawson, a biologist at Berkeley, to run a McDonald's meal through his mass spectrometer and calculate how much of the carbon in it came originally from a corn plant. It is hard to believe that the identity of the atoms in a cheeseburger or a Coke is preserved from farm field to fast-food counter, but the atomic signature of those carbon isotopes is indestructible, and still legible to the mass spectrometer. Dawson and his colleague Stefania Mambelli prepared an analysis showing roughly how much of the carbon in the various McDonald's menu items came from corn, and plotted them on a graph. The sodas came out at the top, not surprising since they consist of little else than corn sweetener, but virtually everything else, we

ate revealed a high proportion of corn, too. In order of diminishing corniness, this is how the laboratory measured our meal: soda (100 percent corn), milk shake (78 percent), salad dressing (65 percent), chicken nuggets (56 percent), cheeseburger (52 percent), and French fries (23 percent). What in the eyes of the omnivore looks like a meal of impressive variety turns out, when viewed through the eyes of the mass spectrometer, to be the meal of a far more specialized kind of eater. But then, this is what the industrial eater has become: corn's koala.

So WHAT? Why should it matter that we have become a race of corn eaters such as the world has never seen? Is this necessarily a bad thing? The answer all depends on where you stand.

If where you stand is in agribusiness, processing cheap corn into forty-five different McDonald's items is an impressive accomplishment. It represents a solution to the agricultural contradictions of capitalism, the challenge of increasing food industry profits faster than America can increase its population. Supersized portions of cheap corn-fixed carbon solves the problem of the fixed stomach; we may not be expanding the number of eaters in America, but we've figured out how to expand each of their appetites, which is almost as good. Judith, Isaac, and I together consumed a total of 4,510 calories at our lunch—more than half as many as we each should probably consume in a day. We had certainly done our parts in chomping through the corn surplus. (We had also consumed a lot of petroleum, and not just because we were in a car. To grow and process those 4,510 food calories took at least ten times as many calories of fossil energy, the equivalent of 1.3 gallons of oil.)

If where you stand is on one of the lower rungs of America's economic ladder, our cornified food chain offers real advantages: not cheap food exactly (for the consumer ultimately pays the added cost of processing), but cheap calories in a variety of attractive forms. In the long run, however, the eater pays a high price for these cheap calories: obesity, Type II diabetes, heart disease.

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however, America's corn-fed food chain looks like an unalloyed disaster. I mentioned earlier that all life on earth can be viewed as a competition for the energy captured by plants and stored in carbohydrates, energy we measure in calories. There is a limit to how many of those calories the world's arable land can produce each year, and an industrial meal of meat and processed food consumes—and wastes—an uncountable amount of that energy. To eat corn directly (as Mexicans and many Africans do) is to consume all the energy in that corn, but when you feed that corn to a steer or a chicken, 90 percent of its energy is lost—to bones or feathers or fur, to living and metabolizing as a steer or chicken. This is why vegetarians advocate eating "low on the food chain"; every step up the chain reduces the amount of food energy by a factor of ten, which is why in any ecosystem there are only a fraction as many predators as there are prey. But processing food also burns energy. What this means is that the amount of food energy lost in the making of something like a Chicken McNugget could feed a great many more children than just mine, and that behind the 4,510 calories the three of us had for lunch stand tens of thousand of corn calories that could have fed a great many hungry people.

And how does this corn-fed food chain look if where you stand is in the middle of a field of corn? Well, it depends on whether you are the corn farmer or the plant. For the corn farmer, you might think the cornification of our food system would have redounded to his benefit, but it has not. Corn's triumph is the direct result of its overproduction, and that has been a disaster for the people who grow it. Growing corn and nothing but corn has also exacted a toll on the farmer's soil, the quality of the local water and the overall health of his community, the biodiversity of his landscape, and the health of all the creatures living on or downstream from it. And not only those creatures, for cheap corn has also changed, and much for the worse, the lives of several billion food animals, animals that would not be living on factory farms if not for the ocean of corn on which these animal cities float.

But return to that Iowa farm field for a moment and look at the matter—at us—from the standpoint of the corn plant itself. Corn, corn,

corn as far as the eye can see, ten-foot stalks soldiering in perfect thirty-inch rows to the far horizon, an 80-million-acre corn lawn rolling across the continent. It's a good thing this plant can't form an impression of us, for how risible that impression would be: the farmers going broke cultivating it; the countless other species routed or emiserated by it; the humans eating and drinking it as fast as they can, some of them—like me and my family—in automobiles engineered to drink it, too. Of all the species that have figured out how to thrive in a world dominated by *Homo sapiens*, surely no other has succeeded more spectacularly—has colonized more acres and bodies—than *Zea mays*, the grass that domesticated its domesticator. You have to wonder why we Americans don't worship this plant as fervently as the Aztecs; like they once did, we make extraordinary sacrifices to it.

These, at least, were my somewhat fevered speculations, as we sped down the highway putting away our fast-food lunch. What is it about fast food? Not only is it served in a flash, but more often than not it's eaten that way too: We finished our meal in under ten minutes. Since we were in the convertible and the sun was shining, I can't blame the McDonald's ambiance. Perhaps the reason you eat this food quickly is because it doesn't bear savoring. The more you concentrate on how it tastes, the less like anything it tastes. I said before that McDonald's serves a kind of comfort food, but after a few bites I'm more inclined to think they're selling something more schematic than that—something more like a signifier of comfort food. So you eat more and eat more quickly, hoping somehow to catch up to the original idea of a cheeseburger or French fry as it retreats over the horizon. And so it goes, bite after bite, until you feel not satisfied exactly, but simply, regrettably, full.

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