

to disturb the soil each year.

Each time we plow, we simplify the soil, taking away some of its capacity to grow crops. We break apart its intricate architecture and wreak havoc with the dream team of microfauna and microflora that glues it together into colloids, or clumps, of soil and organic matter. This clumping is vital; it leaves air channels like veins throughout the soil, giving water a way to sink down deep. Soils that are plowed too fine or packed too hard lose their colloids, and with them the art of retaining water. Parched air sucks the ground dry, and when the winds blow, talcum-powder topsoil coats the hoods of cars in town.

When rain strikes the hard pack, it can't shimmy down to the miles of thirsty roots as it should. Instead it glances off and runs in sheets, rills, and rivulets, murky and bloodstained, to the sea. The blood is soil, the living plasma of the Earth, sloughed off at a rate of five to one hundred tons per acre per year—a massive heist. Some Palouse Prairie wheat fields in Washington, on the shameful side of that equation, have the potential to lose one inch of topsoil every 1.6 years. In Iowa, up to six bushels of soil are washed out to sea for every bushel of corn produced.

What's left behind is a little deader as well as a little thinner. Behind the rest stop on Highway 7, I trespass a ways into a Kansas wheat field and bring up a handful of the bladed, pulverized, chemically amended soil. It's not chocolate-pudding black like the soil under the first plowed prairies must have been. It's beige and it doesn't smell as dank or fecund as it should—it doesn't smell like death and life commingled. The fungi that once wrapped their threads around rootlets to extend their reach, the brotherhoods of beneficial soil organisms, the bacteria that spun airborne nitrogen into food—they're all down to a skeleton crew, a shadow of their former selves. With the links among them severed, there is less "bootstrapping," less of the power that comes from several species working in biotic conspiracy to lift up the whole community.

The wildly fertile "postage stamp" prairies still scattered throughout the Great Plains give fragmentary testament to what we once had. In his eloquent book *The Grassland*, Richard Manning describes these vestiges as "pedestals carved by the plow." From the crown of some of these pedestals, once level with the land, you now have to drop down three feet to reach plowed soil. Such is what we have lost.

In other places, the scalp of the Earth is so thin that our plows are already mixing it with subsoil, which doesn't have the organic history that topsoil has. The grand larceny of harvest removes even more organic matter from these fields. Even in places where the stubble is plowed back in before planting, the nutrients are often wasted, pried away by hard rains before any plants are even visible. Over the years, these heists and the mistimed feedings add up to decreased fertility, a slow sterilization of our nation's real goose with the golden eggs. "Over a mere century of tilling the prairie soils of North America," says ecologist Jon Piper in his book *Farming in Nature's Image*, "we have lost one third of their topsoil, and up to 50 percent of their original fertility."

Part of our loss can be traced to our fetish for production, our eagerness to turn an organic, nature-based endeavor into a factory: the farm as machine. Author and Kentucky farmer Wendell Berry says Europeans came to this continent with vision but not with sight—we couldn't see the value of what was right before us. We set to work removing the land's native dress and imposing a pattern of our own making. Exotic plants instead of indigenous ones, annuals instead of perennials, monocultures instead of polycultures. This disruption of a natural pattern, says Wes Jackson, is the definition of hubris.

Rather than looking to the land and its native peoples for instructions (what grows here naturally and why?), we issued arbitrary orders, expecting our farmland to fulfill many agendas, some of which had nothing to do with feeding people. Wheat, for instance, was leveraged to help us win the First World War. The European continent was overoccupied with fighting, and in many places, crops were neither planted nor harvested. To fill that void, we boarded battalions of newly motorized tractors and plowed our home soil right up to the Rockies, uprooting massive amounts of virgin prairie in what would later be called the Great Plow-up.

This was the finale of a movement that had begun with the first sodbusters and their steel-laminated moldboard plows, the only tools strong enough to break the tangle of prairie roots, some as stout as a homesteader's arm. It was considered backbreaking but heroic work, at least by white settlers. A Sioux Indian watching a sodbuster turn prairie roots skyward was reported to have shaken his head and said, "Wrong side up." Mistaking wisdom for backwardness, the settlers laughed as they retold the story,

ignoring the warning shots that fired with each popping root.

Having broken the prairie, we were ripe for the 1930s disaster of deep drought and relentless winds called the Dust Bowl. It got so bad our topsoil started showing up on the decks of ships a hundred miles off the Atlantic coast. One day in 1935, as officials in Washington, D.C., were hemming and hawing about what to do, a cloud of Great Plains soil fortuitously blew into town. A frightened Congress coughed, teared, and eventually created the Soil Conservation Service (SCS), an agency that would cajole and even pay farmers to conserve their soil. SCS agents were evangelical, and farmers were ready to repent, and together they were successful in getting our most erodible lands replanted to perennial, soil-holding grasses.

The institutional memory proved short, however, and when another world war had come and gone, we looked around and wondered why we weren't "using" every inch of the breadbasket. Earl Butz, the secretary of agriculture under Richard Nixon, reflected the nation's hubris by admonishing farmers to plow "fencerow to fencerow." Forgetting the lessons of the Dust Bowl, farmers filled in draws and bulldozed windbreaks, spending millions of federal dollars to obliterate what the SCS had spent millions of dollars planting.

We now had acres of new canvas on which to paint the next face of industrialized farming: the Green Revolution. In what was heralded as the answer to world starvation, breeders unveiled new hybrid strains of crops that promised phenomenal yields. Because of their hybrid nature, however, these new plants couldn't pass their genetic traits on to the next generation. So farmers around the world abandoned the time-honored (and ecologically prudent) tradition of seed saving and added a new expense to their ledgers: purchasing hybrid seeds.

The homogenization of fields spread rapidly. Varieties of crops that had once been used because they did well on a south-facing slope or were able to prosper in the Banana Belt or the Little Arctic regions of a state were forgotten. In places like India, where there were once thirty thousand land-tailored varieties of rice, their replacement by one super variety swept away botanical knowledge and centuries of breeding in one fell swoop.

Too late, farmers realized that touted yields were only promised, not guaranteed. In your part of the world, the fine print read, you may have to do a little goosing to get advertised yields—more water, more thorough tilling,

more pest protection, more artificial fertilizer. But once the farmer next door had taken the bait and started to grow high-yielding varieties, you had to as well, so as not to be left behind. Together, like a slow pour over a large falls, we switched to a system of farming that mimicked industry, not nature.

Chasing economies of scale, experts advised farmers to get big or get out. Mechanization allowed them to “service” larger fields with less labor, but it meant steep capital investments: more land, bigger equipment, enormous debt. For the small operator, there was suddenly no room to dance in the margin, or to take care of your land the way you’d like. When you are in debt for a \$100,000 combine, you can’t afford to switch to alfalfa one year to rest the land. To hold the debt at bay, and to qualify for government subsidies, you have to farm volume.

We quickly went from growing food to sustain ourselves to growing so much food it became a surplus—an export item and a political tool. The farm became just another factory producing another product that would keep the United States in the global catbird seat. The internal controllers, those farmers with their ears to the land, determined to pass on good fertile soil to their progeny, gave way to remote-distance controllers—agribusiness and public policy.

To serve these “distance princes,” as *Grassland* author Richard Manning puts it, industrial farmers abandoned traditional ways of managing their lands, such as rotating crops, liming and fertilizing with animal manure, or producing a diversity of products in case one crop failed. Instead, they “focused” their farms—selling off their livestock and switching to one species grown in continuous cropping, which is, in effect, continuous robbing. They propped up flagging soil fertility with artificial nitrogen fertilizer produced with natural gas. Weed competition was quelled with herbicides, another petroleum product, while oil-based chemicals were used as a prophylactic against pest outbreaks (which by now were extreme, thanks to acres of identical plants with identical vulnerabilities). Suddenly, for the first time in ten thousand years of agriculture, farmers were beholden to the protection ring of petroleum and chemical companies, and were said to be growing their crops not so much in soil as in oil.

Once on that treadmill, the feedback loops began. Weeds and pests are wily by nature, and even if you spray them one year, not all of them will die. Those that manage to hack an immunity explode the next year, requiring even