***Name*_____ *per.* _____**

You Are Contaminated

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Everywhere they look, they find particles of pollution, like infinite spores in an endless contagion field. Scientists call that field the exposome: the sum of external exposures encountered by each of us over a lifetime, which portion and shape our fate alongside genes and behavior. Humans are permeable creatures, and we navigate the world like cleaner fish, filtering the waste of civilization partly by absorbing it.

There is plastic in salty sea foam freshly sprayed by crashing waves, in dreamy Japanese mountaintop clouds and in the breath of dolphins. When scientists test Antarctic snow or the ice on Mount Everest, plastics are there. When, in 2019, an explorer reached the ocean's greatest depths in the otherworldly Mariana Trench, he found that plastics had beaten him there, miles past the reach of natural light.

Plastic is now threaded through the flesh of fish, where it is interfering with reproduction, and the stalks of plants, where it is interfering with photosynthesis, and in much else we place on our dinner plates and set about eating. There might be plastic in your saliva and almost certainly in your blood. Plastic has been found in human hearts and kidneys and other organs, in the breast milk expressed by new mothers and on both sides of placentas. And because plastic has been found in ovarian follicular fluid and testicular tissue and in a majority of sampled human sperm, it is already embedded in not just the yet to be born but also the yet to be conceived.

The penetration appears so complete that some researchers have begun to worry that their methods, too, are compromised by ambient contamination and plastic materials in the lab. Some have called for whole new protocols to systematically stress-test the findings of their colleagues, which seem on first blush simply impossible. But to trust their findings is to believe, for instance, that the buildup inside brain tissue has grown 50 percent in just eight years and that, as of last year, there might be inside your skull the equivalent of a full plastic spoon — by weight perhaps one-fifth as much polymer as there is brainstem in there.

It isn't just plastics. Centuries after we began using the term "nature" to describe what it was that modern civilization was despoiling — and several decades since the environmental writer and activist Bill McKibben warned of the end of nature — there is no longer really such a thing, or such a place, as pristine. There is now some kind of contaminate

A more poetic phrase is "second body," which comes from the essayist and novelist Daisy Hildyard, whose beautiful 2017 book of the same name sketches a twinned experience; alongside your fleshly body is another kind, distended through overlapping and external ecosystems. If memory is a butterfly net, collecting some magical fluttering treasures and letting others fly free, so too are those second bodies, trawling for poisons alongside other morsels to eat and breathe and otherwise shape into the stuff of personal fate.on in much of what we eat and breathe and touch, which is how it gets inside us: by digestion, in the gut; via respiration, in the lungs; and through our pores, the smallest particles delicate enough to slip through the skin when they aren't being carried, practically weightless, thousands of miles through the air. This essay is the first in a series on the subject, on the

way our lives are embedded in ecological context, and vice versa, each of us inescapably linked to one another and to the external world, now woven through with waste.

“Your first body could be sitting alone in a church in the center of Marseille,” Hildyard writes, “but your second body is floating above a pharmaceutical plant on the outskirts of the city, it is inside a freight container in the docks, and it is also thousands of miles away, on a flood plain in Bangladesh, in another man’s lungs.”

Beyond plastics, there is PFAS, that category of long-lasting industrial compounds often called forever chemicals, pervasive enough that the better branding might be “everywhere chemicals”: found in sea foam and sewage sludge used as fertilizer; in our eggs, in our seafood, in our food wrappers and nonstick pans; in fields of artificial turf, in groundwater serving up to 95 million Americans and in almost half of sampled tap water in the country. “There’s a new acid in our rain,” the journal Nature recently declared, referring to the forever chemical TFA, which has, in two decades, grown six times as prevalent in American surface waters.

Endocrine-disrupting chemicals called phthalates have been found in cosmetics and perfumes and shampoo. And because of the presence of what are called polycyclic aromatic hydrocarbons, cancer risk for children has been estimated to be 10 times as high in playgrounds with poured rubber surfaces (introduced to cushion children when they fall) as in uncovered soil playgrounds.

River deltas are flowing full with nitrogen and phosphorus fertilizer runoff, producing, when flushed into larger bodies of water, some of the oceans’ most notorious anoxic dead zones. Increasingly, waterways are suffused with pharmacological runoff, too: antidepressants and anti-anxiety medications, cocaine and methamphetamine, heart medicine and painkillers. Up to 80 percent of studied American streams are positive for some kind of chemical or drug contamination; researchers estimate that more than 8,000 tons of antibiotics are now discharged into the world’s river systems each year, with 750 million people living within 10 kilometers (six miles) of rivers in which antibiotics exceed accepted standards.

Over the past couple of decades, geologists and like-minded ecologists began to popularize the term “Anthropocene” to describe the new world we all now inhabit — in which, for instance, 96 percent of mammal life by mass is humans and their livestock. Others tracked the many measures of what they called the Great Acceleration — global explosions of not just carbon dioxide emissions but also methane and nitrous oxide, among other forms of pollution and ecosystem degradation. “Maybe this has been our fate all along,” Mark O’Connell wrote in 2023: “to achieve final communion with our own garbage.”

From above comes smoke, with wildfires now routinely blanketing not just the West but also the Great Plains and dense urban areas with thick, toxic clouds. And even when clear, the air is alive, as The Times’s Carl Zimmer has written, with each of us breathing in more than 2,000 gallons of it daily — full of spores and microbes and the industrial detritus known as particulate matter, too. Air pollution, produced primarily by the burning of fossil fuels, kills millions of people each year globally, and though the number is steadily declining, more than 90 percent of the world still breathes technically unhealthy air.

You may wonder, then, what we mean by “unhealthy.” But the list of medical consequences associated with particulate exposure is long and growing: respiratory disease and cardiac conditions, developmental disorders and various cancers, dementia and Alzheimer’s and

premature birth and low birth weight. Studies suggest a link between exposure to air pollution and damaged cognitive performance and economic performance and increased rates of violent crime and hospitalization for mental-health disorders.

Recent research has found a connection between such pollution and genomic changes in the tumors of lung cancer patients who had never smoked, and the chemical contamination produced by wildfire smoke can be detected in local waterways as many as eight years later. And because trees absorb some particulate matter, cutting them down to clear land for roads and agriculture can be powerfully consequential for human health, with one recent paper suggesting Brazilian deforestation was responsible for over 700,000 premature deaths through its effects on air pollution.

The all-over-everywhere penetration of waste is a marvel of industrial civilization, in its way, a sign that a certain kind of human conquest over the planet may be approaching its apex. But it is also not exactly new.

Scientists began taking note of plastic in the ocean in the 1960s and '70s, around the same time the E.P.A. was established to fight dozens of other forms of environmental contamination, often more visible. And growing recent alarm illustrates one perversely reassuring paradox of some pollution research: With particulate matter, for instance, the findings have gotten grimmer just as the menace itself has begun to subside. In some cases, you can even see the tally of pollution effects as a sign of broader progress, since in previous generations people didn't live long enough or healthily enough for the damage to really register. Nevertheless, there was harm.

There were those who knew that lead was toxic nearly 2,000 years ago, before anyone tried to leaven gasoline with it; Pliny the Elder called lead a "deadly poison." Yet half of Americans alive today were exposed to dangerous levels of lead as children, and half of children in the developing world have lead poisoning; one estimate suggests lead was responsible for more than five million cardiovascular disease deaths in a given year, in addition to impeding neurological development and in ways that have been linked to increased criminal behavior.

Some have suggested that lead explains the sudden rise of serial killers in the United States during the 1970s and '80s and others that you can write the whole history of postwar American politics in lead: an inner-city crime wave, supercharged by leaded gas and paint, powering white flight and suburbanization and the racialized politics that followed. This is not to mention the thesis that lead exposure uniquely deformed the brain development of Generation X or recent research suggesting such poisoning could have helped bring down ancient Rome — which, other historians now say, was felled in part by the contagion of plague.

Viruses and bacteria form a contagion field, as well, shaping some lives long after an initial illness subsides. We learned this pattern during the pandemic and fearfully called it long Covid before devolving into debates about whether it was real. A better term might be "long everything," since infections of all kinds have knock-on effects, many of them hard to believe at first: that Epstein-Barr, which also causes mononucleosis, may elevate your risk of multiple sclerosis 32 times over, that the parasite Toxoplasma gondii, common in house cats, can nearly double your risk of schizophrenia and that "sleeping" cancer cells in the lungs can be reactivated in patients in remission by infection with flu or Covid-19 viruses. Perhaps this seems a bit eerie, but we might want to apply the same frame to many more aspects of the exposome: that much of what we chalk up to chance or bad luck may prove, in time and in part, explicable.

In the aftermath of the pandemic, MAHA has proselytized about the infiltration of our agriculture by chemical contaminants, and though the current risks to human health from pesticides and foods that MAHA has singled out appear somewhere between modest and trivial, the fact of environmental contagion through farming is real.

Some studies suggest exposure to multiple pesticides might raise the risk of pregnancy complications and could increase the risk of childhood brain cancer by more than a third. Iowa reports the country's second-highest cancer rates, which some researchers and residents suspect is the result of pesticides and insecticides and fertilizer. Simply living near a golf course, one study recently documented, can more than double your risk of Parkinson's, probably through exposure to pesticides sprayed on the grass and seeping into local waterways. The effect is sometimes called pesticide drift, which suggests that another way of imagining the exposome is through the evocative phrase "drift harms."

If this all triggers expansive, even mythic reveries in you, well, it does in me, too. Americans have been so raised on stories of self-reliance and self-ownership, the principles of personal responsibility and personal agency and personal autonomy, that it is hard to make room for any ecological influence without drawing on analogies that seem squishy, conspiratorial, New Agey, naïve.

But I think of the immanent, capricious spirits of our polytheistic past or of the shadow stitched back onto the stockinged leg of Peter Pan. I think of the way that environmental conditions have so shaped the lives of humans that we know them now, from elementary school, as a species-scale evolutionary force — even while we tell ourselves, seemingly every day, that we are the masters of our own destinies.

I think of environmental forces helping bring about the collapse of whole empires, from the Akkadian to the Ming. I think of everything we've learned about the gut microbiome, in recent years — its potential to regulate mood and body mass and the progress of disease and mental health — and what it would mean to expand the horizon of that understanding so that it lassoes much more of the external world into its conceptual reach. I think of smoke escaping from a point source, then dissipating and descending, seeding the surrounding community with just a few more cases of cancer or C.O.P.D. Inside those homes, whether they lie within what are called sacrifice zones or beyond them, do those grieving the dead think to ask what killed them?

Humans are porous beings, in ways more fluid than fortress. And though environmental contamination is not new, it increasingly plays like a grievous violation: In an age of social atomization we are growing ever more enamored with the ideal of the independent self and the fantasy of the body as autonomy incarnate. In its maximalist form, at least, each is an illusion. Every time we pant or press or swallow, we welcome into not just our delicate biology but into those cherished fables, too, the ecological influence of the exposome.

As ever, the news sounds hysterical, so many hair-raising headlines about environmental contamination that it can be hard to judge what is new or newly alarming. And perhaps it is a bit hysterical. The precise effects remain broadly mysterious, partly because the science of the exposome is young, and when it comes to matters of what MAHA calls bodily autonomy, we tend to fill in blanks with panic.

You may read about a connection between microplastics and diabetes or come across the phrase "Teflon flu." You may hear warnings from influencers and government health officials, too, about a chronic illness epidemic or even the universal poisoning of our children. But the signs we can recognize today point toward something more like unsettling

degradation than an onrushing medical apocalypse. Look out over the horizon at the shape of human health, and the effects do not exactly stand out like lighthouses. You've got to look a bit more closely.

Eighty percent of people's blood samples may contain microplastics, after all, but 80 percent of us aren't yet dying of blood cancers. Colorectal cancer does not dominate health outcomes for those under 50, but environmental contamination may play a role in its recent rise among the young. Overall, cancer death rates have been dropping, and survival rates have been rising, for the many decades of pollution's Great Acceleration. And though we encounter reports now daily, it seems, about toxic substances in our baby food and our tampons, our air fresheners and our yoga pants, we rarely ask: How toxic? At what dose? To how many? And compared with what?

The dose matters, which is why it might be safer to eat food from an industrial farm than to live next door to it. But each element of the contagion field, growing or shrinking, is also governed by what I call the rule of little numbers in a big world, which explains how even small effects quickly add up.

Perhaps a novel disease kills fewer than 1 percent of those infected, but when billions fall sick, the death toll grows world-historical. Perhaps you are breathing air tainted with wildfire smoke only several weeks each year, and perhaps the risks to your health are only on the margins, but when the same is true for tens of millions across the West — or Midwest or Eastern Seaboard — the damage mounts. For anybody in particular, the additional danger can seem trivial. But no accounting at the individual level truly tells the story of ecological risk, which is held collectively, however unequal its distribution. And no individual action is sufficient to eliminate it. This is, of course, a fundamental principle of public health, though in the aftermath of our most recent public health emergency the country appears to have turned away from it.

Whole environmental movements of the past were built on fears of incipient contamination. But what are the lessons when pollution is seemingly everywhere and in everyone already?

Today it is no longer entirely rational to imagine an escape, though, reflexively, we do so anyway, entertaining fantasies of purification and paying for novel detox treatments. Perhaps we will soon be cultivating gut microbes to chew through PFAS collecting in our digestive tracts; perhaps we will unleash microscopic G.M.O. sanitation teams on 27 million metric tons of nanoplastics in the oceans. Already, there are those undertaking a kind of boutique dialysis treatment claiming to rid the blood of microplastics. But for most of us, this doesn't seem like the kind of problem you can so easily solve — say, by discarding a worn plastic spatula or restricting your child to wood-chip playgrounds.

Progress through public policy isn't easy, either, though improvements over decades past suggest it is nevertheless possible. Internationally, final negotiations to produce a global plastics treaty begin this week — but in the absence of policy, production is expected to double or triple over the next decades, and global plastic manufacturing has grown more than 400-fold since World War II. The author Assaad Razzouk calls it "the mother of all oil spills," and because plastics are made from fossil fuels, it was put there by some pretty familiar environmental villains. For decades, we were told that the problem of plastic could be solved by recycling, though those in the industry knew it wasn't true and probably would never be.

Domestically, the Clean Air Act counts as probably the most beneficent piece of environmental legislation in American history, saving more than 200,000 lives each year. But the E.P.A. is looking not to extend those gains or the kinds of standards and regulations that produced them. Instead, the agency is moving backward, as rollbacks to environmental policy threaten to unleash mercury and dioxins and even lead into our mouths and lungs. Last month it proposed bringing back the herbicide dicamba, banned twice by federal courts since just 2020, and President Trump granted 12 petrochemical facilities in Louisiana's Cancer Alley two-year exemptions from regulations to reduce cancer risk. As MAHA promises less food dye, MAGA gives us more pollution, as though anyone anywhere were clamoring for it.

If anything, we are clamoring for the opposite: a cleaner and less polluted world, as MAHA, in all its confusion, reminds us. In many cases, in many places, Americans are fighting for piecemeal progress, too — with lawsuits, in state legislatures, with local ordinances — because another lesson of universal-seeming contamination is that while true purification of the world may be a naïve goal, reductions do matter, particularly at the point of production.

Those little numbers add up and also instruct us: Environmental contagion is important not because we can keep everything at bay but precisely because we cannot. The world is inside us now. What are we going to do about it?