What Is Soil?

An Essay on the Living Terrain Beneath Our Feet

UNBEKOMING
MAY 07, 2026

Author’s Note

This essay operates in two registers. When the establishment is being examined — its data, its admissions, its own measurements turned against its own claims — its terminology appears in attribution: "soil microbiome," "soil organic carbon," "mycorrhizal networks," EPA nitrate thresholds, USDA erosion figures. When the terrain framework is stated, the language shifts: terrain, microzyma, pleomorphism, the body-to-soil parallel. The reader should always know which register is operating. The establishment's own evidence is among the strongest material here — not because the establishment is right, but because its own measurements, taken seriously, dismantle its own framework.

Béchamp's Chalk

In the 1860s, Antoine Béchamp performed an experiment any reader can verify against the scientific record of the period. He took natural chalk — calcium carbonate, the same compound chemists were synthesising in their laboratories — from a geological deposit and added it to a sterile solution of sugar and water. The solution fermented. He then took chemically pure calcium carbonate, the synthesised version, and added it to an identical sterile solution. Nothing happened.

He examined the natural chalk under his microscope and found small, rounded particles he could not account for through chemistry. He examined the pure compound and found none. To rule out the obvious objection — that the natural chalk was simply contaminated — he heated the natural chalk to 300°C. After heating, the chalk no longer fermented sugar. The fermentative power had been destroyed by heat.[1]

Béchamp had demonstrated that natural mineral matter contained living units that pure chemistry did not contain, and that those units could be killed by heat. He found the same particles in limestone dating back sixty million years. He named them microzyma — "tiny ferments" — and concluded they were the foundational units of life, present in all living matter and in much that mainstream science considered dead.[1]

The experiment was reproducible. The controls were obvious. It was the kind of demonstration that should have been in every textbook. It is in none of them.

The obvious modern objection — that nineteenth-century microscopy was crude and the finding could not be confirmed with contemporary instrumentation — was answered in 1996, though the answer was largely ignored. Philippa Uwins and her team at the University of Queensland published "Novel Nano-Organisms from Australian Sandstones" in *American Mineralogist*, documenting living organisms recovered from Triassic and Jurassic sandstone retrieved from petroleum exploration wells three to five kilometres beneath the ocean floor. The rocks were 150 to 250 million years old. The organisms — Uwins called them nanobes — were ten times smaller than any known bacteria, between 20 nanometres and 1 micrometre in diameter. Three separate DNA-specific stains (DAPI, Acridine Orange, Feulgen) confirmed the presence of genetic material. Energy-dispersive X-ray spectroscopy showed the elemental composition was carbon, oxygen, and nitrogen — the signature of biological matter, not minerals. Brought to the surface and exposed to room temperature and atmospheric pressure, the nanobes began growing within weeks, spreading across laboratory equipment and forming colonies along human fingerprints where skin oils provided organic substrate.[2] The editor's preface to a modern edition of Béchamp's *The Blood and its Third Element* states the connection plainly: Uwins' nanobes are without doubt what Béchamp described as microzymas. Same finding, same framework, same dismissal — separated by 130 years and two generations of microscopy. (I have written elsewhere about the Béchamp–Uwins connection in detail; the present essay applies the framework to soil rather than re-arguing the foundation.)[3]

The framework Béchamp built from this and similar experiments was rejected not because it failed under further testing but because it threatened the commercial structure that germ theory enabled. If microzyma are real and can change form according to the conditions of their environment — pleomorphism, the property Béchamp's later work documented in detail and which subsequent researchers including Enderlein, Naessens, and Reich confirmed[4] — then "the germ" is not a fixed external invader to be killed but a manifestation of internal terrain. There is nothing to vaccinate against. There is nothing to spray. There is only terrain to nourish.

That framework — terrain rather than germ, internal environment rather than external invader, the body and the land as self-regulating organisms rather than passive substrates — is the framework this essay applies to soil.

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What Soil Actually Is

Mainstream agronomy treats soil as a substrate. A medium. A scaffold of mineral particles — sand, silt, clay — into which roots are planted and onto which inputs are applied. The framework is chemical: nitrogen, phosphorus, potassium, pH, cation exchange capacity. Add what's missing. Buffer what's imbalanced. Spray what threatens yield. The soil itself is treated as inert.

The terrain framework treats soil as a living organism. Not a metaphor — an organism. Self-regulating, homeostatic, capable of repair, governed by the same principles that govern the body. Its health is determined by its internal environment: its toxic burden, its nutritional status, its electromagnetic exposure, its biological integrity. Healthy soil cleanses, adapts, repairs. Damaged soil expels what it cannot process — in symptoms agriculture calls "pests," "weeds," "disease," and "erosion."

In soil, the implication of pleomorphism is precise. The "soil microbiome" that mainstream science has, in the last two decades, finally begun to study is the pleomorphic expression of microzyma in response to the soil terrain. The terrain determines what forms appear. Healthy soil — soil with sufficient organic matter, intact mineral balance, undisrupted electrical character, and freedom from chelating poisons — expresses one set of forms. Sterile, depleted, glyphosate-saturated soil expresses another. Mainstream agronomy treats the second set as pests to be killed, when they are in fact what the terrain is producing because of what the terrain has become.

The body-to-soil parallel runs the whole way down. What human medicine calls chronic disease is what happens to a body whose terrain has been compromised — by toxins, by deficiencies, by electromagnetic insult, by stress — and whose attempts to expel the insult have been suppressed by pharmaceutical intervention until the cycle becomes self-sustaining. What industrial agriculture produces in the soil is the same phenomenon at landscape scale. The framework is the same. The mechanism is the same. The result is the same.

Terra Preta: Terrain Done Right

The most compelling proof that human beings can build hyper-vital terrain — terrain that lasts not for a season but for millennia — sits in the Amazon basin under the name *terra preta de índio*, or Indian dark earth.

European explorers in the 1870s began noticing patches of unusually fertile soil scattered through the Amazon. The surrounding Amazonian soils are typical tropical oxisols: thin, acidic at pH below 4.5, leached of nutrients, capable of supporting only the rapid succession of forest growth that depends on the canopy itself rather than the ground beneath it. Inside the patches of terra preta, the situation reverses. The soil is deep — sometimes two metres or more — black, rich, and pH-balanced near neutral at 7.2 to 8.2. Its soil organic carbon content runs up to seventy times higher than the surrounding latosols. Its phosphorus and calcium content is dramatically elevated. It has supported continuous high yields for centuries, in some cases for over two thousand years, without external input.[5]

Western agronomy has been studying terra preta for over a century and has not been able to replicate it. Modern attempts — adding biochar to sandy substrate, applying compost, fertilising with animal waste — produce something that approaches terra preta in the first season and then fades. The pre-Columbian populations who built terra preta knew something modern soil science has not been able to reverse-engineer.[5]

What we know they used: pyrolysed biomass, animal and human waste deposited over generations, ceramic shards mixed throughout, and time. What they appear to have built: a self-regenerating biological system. Local farmers report that the soil "grows" — that a few centimetres taken from a terra preta plot can be used to inoculate new ground, and over years that ground will itself become terra preta. Western researchers have noted this claim and have not been able to confirm or refute it under controlled conditions, in part because the time horizons required exceed the funding cycles of soil science.[5]

The terra preta evidence does several things at once. It establishes that human beings built the most fertile terrain on the planet — not nature alone, not the indigenous "wilderness" of romantic imagination, but humans working with the living principles of the soil. It establishes that fertility is not consumed by harvest if the underlying terrain is intact. It establishes that the carbon matrix is not a fertiliser additive but the foundational substrate on which the rest of the system organises. And it establishes that mainstream soil science cannot, despite decades of effort and substantial funding, reproduce what an unschooled pre-Columbian people produced — because mainstream soil science is operating from the wrong framework.

Carbon as Habitat

Biochar — the pyrolysed carbon at the heart of terra preta — is not a fertiliser. It contains no nitrogen, phosphorus, or potassium in any amount worth measuring. It does not feed plants. What it does is build habitat.

The mechanism, stated in establishment terminology: biochar produced by high-temperature pyrolysis (above 500°C) has a surface area of several hundred square metres per gram. Its pore structure ranges from macropores capable of moving water to micropores small enough to shelter individual microorganisms from predation. Its hydrophilic surface structures water — in the sense Gerald Pollack has documented[6] — into the ordered phase that biological systems use as their working medium. Its conjugated aromatic structure, established by ^{13}C NMR spectroscopy, gives it strong diamagnetic properties: it resists penetration by external magnetic fields.[7]

In terrain language, biochar is mother-substrate. It does what the porous matrix of healthy bone does for marrow. It does what the structured tissue of the gut does for the microbial life that organises within it. The carbon scaffold provides the shelter, the ordered water, and the protected micro-environments in which biological complexity can develop. This is why terra preta works. This is why a single application of inoculated biochar restores fertility to depleted soil where chemical fertilisers cannot. The carbon is not the food. It is the house.

The diamagnetic property is worth lingering on. In a world saturated with artificial electromagnetic fields — the inevitable consequence of treating the earth itself as the electrical return path for industrial civilisation — a substance that resists penetration by those fields has implications for biological systems trying to function within them. Topher Gardner and the electroculture researcher Chris Winters have begun installing biochar pillars on agricultural land specifically to create zones of electromagnetic silence in which the soil's natural electrical character can re-establish.[8] This is practitioner work, not peer-reviewed clinical research. The mechanism is plausible — diamagnetism is real, biochar's NMR signature is real — but the biological consequences in the field are observed rather than measured. It belongs in the essay as observation, flagged as such.

What is not flagged as such is the underlying principle. Carbon is the foundation of biological life on this planet. Soil that has carbon is soil that can host life. Soil that has been stripped of carbon — through extractive agriculture, through synthetic chemistry, through the elimination of the deep-rooted perennial systems that historically built it — is soil that cannot. Restoration begins with the carbon. Everything else follows.

Iowa: Terrain Done Wrong

Iowa, before the plough, had soil so deep and rich that early travellers wrote of grass tall enough to lose a horse in. The native mollisols held organic matter in concentrations exceeding ten percent. They were the product of ten thousand years of prairie ecology — fire, grazing, deep-rooted perennial grasses — slowly building a terrain that was, in its own way, North America's terra preta.

That terrain has been liquidated.

The USDA, the Natural Resources Conservation Service, and Iowa State University all document the figures. Sheet and rill erosion in Iowa now runs at 5.2 tons per acre per year. Wind erosion adds another 0.5 tons. The natural rate of soil formation in Iowa's climate is 0.24 tons per acre per year — about one twenty-fourth of the loss rate.[9] Over half of Iowa's original topsoil has been lost since cultivation began. Over half of its original soil organic matter is gone. The Daily Erosion Project, which monitors localised erosion events, has recorded individual storms stripping more than fifty tons per acre from a single field — meaning two centuries of natural soil formation gone in a single rainfall.[9]

These are not figures from terrain practitioners. These are figures from the federal agencies whose mandate includes American agricultural productivity.

The consequences are visible in the water. Central Iowa Water Works, the regional utility serving six hundred thousand people drawing primarily from the Raccoon and Des Moines rivers, ran its nitrate removal facility for fifty-five consecutive days in spring 2025 before declaring the first mandatory lawn-watering ban in the history of the Des Moines metro on June 12. The ban was imposed not because there was insufficient water, but because the river nitrate concentrations were running at the second-highest levels ever recorded — last seen in 2013 — and the utility's treatment capacity was no longer adequate to keep finished water below the EPA threshold of 10 mg/L. Operating the nitrate removal facility costs sixteen thousand dollars per day. Raccoon River concentrations through June and July repeatedly ran above thirteen milligrams per litre, well above the federal limit, requiring continuous dilution and filtration before the water could legally be delivered to customers' taps.[10]

The nitrate is not a manufacturing accident. It is the predictable end-product of a soil terrain that has lost the biological capacity to retain what is applied to it. Microbial production of nitrate continues — soil biology will produce nitrate as a normal output of organic decomposition — but the diverse living network that historically absorbed and recycled it is gone. So the nitrate runs off, into the drainage tiles, into the streams, into the Raccoon, and ultimately into the Mississippi and the Gulf of Mexico, where it feeds the hypoxic dead zone that now covers thousands of square miles of what was once productive fishery.[10]

This is the Sheltonian suppression cycle made visible at landscape scale.

Herbert Shelton, working in human medicine, described how the body's efforts to expel toxins are met with pharmaceutical suppression, which adds new toxins, which provoke new symptoms, which are suppressed in turn, until what began as acute illness becomes chronic disease. The same mechanism, applied to land, produces the agricultural sequence Iowa now exhibits. Synthetic fertilisers in the 1940s provided immediate yield gains while suppressing the biological networks that built native fertility. The resulting weakened plants attracted pests — nature's clean-up crew for nutritionally deficient organisms, exactly as William Albrecht described it from his chair at the University of Missouri.[11] Pesticides were applied to suppress the pests. The pesticides further sterilised the soil microbial community. New "super-pests" evolved in the toxic terrain. Stronger herbicides — culminating in glyphosate — were deployed. Then genetically modified crops were engineered to survive the herbicides. Each intervention created the conditions requiring the next intervention. The chemical inputs became permanent. The biological capacity of the soil collapsed.

The economics now lock the system in place. USDA subsidies flow disproportionately to large industrial operations. Over ninety percent of major commodity crops in the United States are genetically modified, requiring annual seed purchases from a small number of corporations.[12] The farmers who would prefer to step off the chemical treadmill find they cannot — their soil, after decades of suppression, no longer functions without the inputs. A field that has lost its biological matrix cannot be returned to fertility in a season. The transition takes years and costs money, and the bankers who hold the operating notes do not finance transitions to systems producing yields below the modelled average.

This is not policy capture as a side effect. It is the system functioning exactly as it was designed to function. The problem is not corruption. The problem is that the underlying framework — soil as inert chemical substrate, fertility as input-dependent, "pests" as enemies to be killed —

was wrong from the beginning, and ninety years of operating on the wrong framework has produced terrain collapse on a scale the framework itself cannot perceive, because the framework has no measurement for terrain.

The Chelating Poison

Glyphosate, manufactured under the trade name Roundup and now used as a generic in agricultural quantities measured in millions of tonnes per year, is marketed on the basis that it inhibits a metabolic pathway — the shikimate pathway — that mammals do not possess. The argument is that the chemical is therefore harmless to humans.

The argument is false in two ways. The shikimate pathway is present in the bacteria that constitute the human gut microbiome — but more importantly for soil, it is present in nearly all soil bacteria, fungi, and the microzymian foundation on which both depend.[13] Glyphosate sterilises soil. That is what it does, by mechanism. It is not a side effect.

The second mechanism is more insidious. Glyphosate is a potent metal chelator. It binds to manganese, zinc, magnesium, iron, and calcium, rendering them biologically unavailable.[13] Crops sprayed with glyphosate, even glyphosate-resistant GMO crops engineered to survive the herbicide, are growing in soil whose mineral matrix has been progressively depleted of accessible micronutrients. Peer-reviewed analysis has documented lower concentrations of protein, iron, and zinc in glyphosate-resistant soybeans compared to non-GMO varieties grown in equivalent soil.[13] The plants cannot mineralise what is not bioavailable to them.

The cascade follows a predictable arc. Soil sterilisation removes the microbial networks that historically delivered minerals to plants in bioavailable form. Mineral chelation removes from the soil's chemical pool the elements those networks would otherwise deliver. Plants grow. They photosynthesise. They produce calories. They do not produce the mineral and micronutrient density that historically defined them as food.

Donald Davis and colleagues at the University of Texas published the landmark documentation of this cascade in 2004, comparing USDA nutrient data for forty-three vegetables and fruits between 1950 and 1999. The median declines reached statistical significance for six nutrients: calcium down 16 percent, phosphorus down 9 percent, iron down 15 percent, riboflavin down 38 percent, ascorbic acid (vitamin C) down 15 percent, protein down 6 percent.[14] These are USDA's own numbers. The establishment's own measurement system, applied to the establishment's own food supply, documents a half-century decline in nutritional density that the establishment's own framework cannot explain.

Subsequent research has documented further declines. Anne-Marie Mayer's analysis of British food composition data found calcium down 19 percent and magnesium down 35 percent in twenty vegetables between 1936 and 1991. Finnish data documented a 25 percent reduction in zinc and magnesium in cereals and vegetables over thirty years. Independent analyses of mineral content across thirteen fruits and vegetables in the United States between 1963 and 1992 found calcium declines of 29 percent and iron declines of 32 percent.[14]

What does this mean for the human body? It means a person eating an apple in 2025 is consuming, for the same caloric intake, substantially less of the mineral and vitamin substrate from which the body builds tissue, repairs damage, and maintains homeostasis. The terrain of the human being, which depends on the terrain of the food, which depends on the terrain of the soil, has been progressively impoverished for three generations. The bodies of modern people are being asked to operate on inputs that no human population before us was ever asked to operate on. The chronic disease epidemiology that mainstream medicine treats as a series of disconnected idiopathic conditions — and treats with pharmaceutical suppression — is, viewed from the terrain framework, a single phenomenon with a traceable agricultural origin.

The Iowan whose terrain is dead and the Iowan whose body is sick are eating from the same sequence of decisions.

The Lineage of Restoration

The terrain framework in soil is not new. It has a lineage as long and as decorated as anything in mainstream agricultural science, and it has been progressively marginalised by the same commercial forces that marginalised Béchamp.

Sir Albert Howard, working in colonial India in the 1920s and 1930s, formulated the Law of Return: the principle that all organic waste must be returned to the soil if the soil is to maintain itself. His *Agricultural Testament* (1940) is the foundational text of organic agriculture. His observation that healthy soil produced healthy plants which produced healthy animals which produced healthy people is the body-to-soil parallel stated in the language of an English agronomist eighty-five years ago.[15]

Eve Balfour, founding the Soil Association in Britain in 1946, established the first long-running comparison trial between organic and chemical agriculture and documented the differential. Her *The Living Soil* remains a landmark.[15]

Rudolf Steiner, lecturing in 1924, introduced biodynamic agriculture — a framework that explicitly treats the farm as a self-regulating organism and takes seriously the energetic and electrical character of the soil terrain. The biodynamic preparations he prescribed are dismissed by mainstream science as occult, but the underlying principle — soil as a living system requiring stimulation rather than fertilisation — is consistent with everything Béchamp's work implies.[15]

William Albrecht, professor of soils at the University of Missouri from 1916 to 1959, documented the relationship between soil mineral balance and plant health. His clearest statement: pests are not invaders to be killed. They are the clean-up crew for nutritionally deficient plants growing in imbalanced soil. Address the soil, address the pest. Albrecht's work was peer-reviewed, mainstream, and published in establishment journals, and it has been progressively buried beneath the chemical paradigm that supplanted it.[11]

Masanobu Fukuoka, in *The One-Straw Revolution* (1975), described "do-nothing farming" — agriculture that minimises human intervention so that the soil's own intelligence can re-emerge. His farm in Japan produced rice yields equal to or exceeding the surrounding chemical operations, with no fertiliser, no pesticide, no plough, and no weeding.[15]

The modern lineage continues. Topher Gardner, manufacturing pyrolysed carbon at industrial scale through Black Gold Biochar, returning the carbon matrix to land that has been stripped of it. Chris Winters, investigating electroculture and the restoration of the soil's natural electrical potential. Veda Austin, documenting water's structural memory and the role of structured water in living systems. Dr. Marizelle Arce, continuing the microscopy lineage Béchamp began, bringing twenty-first-century instrumentation to bear on the microzymian foundation Béchamp first identified.[8]

This is not a fringe. It is the original tradition of agricultural science, restored.

What Soil Is

Soil is not a substrate. It is not a chemical scaffold. It is not an inert medium that can be drained, sprayed, and replenished from a tank.

Soil is a living terrain, governed by the same principles that govern the body, populated by the same foundational units Béchamp identified in human tissue and in mineral matter that pure chemistry could not account for. Its health is determined by its toxic burden, its nutritional integrity, its electromagnetic environment, and the biological depth of its carbon matrix. When that matrix is intact, soil cleanses, retains, repairs, and produces. When that matrix is destroyed — by chelating poisons, by sterilising chemicals, by the elimination of the carbon scaffold on which it organises — soil expels what it cannot process and ceases to support life.

What Iowa shows is what happens when industrial agriculture is allowed to operate, unchecked, for three generations on a framework that does not recognise terrain. Half the topsoil gone. Half the organic matter gone. The water of six hundred thousand people requiring industrial filtration, with the regional utility imposing its first-ever mandatory lawn-watering ban in 2025 to keep finished water below the federal nitrate limit. The Gulf of Mexico's fishery dying from what the rivers are carrying off the fields. The food being grown on the surviving soil is measurably less nutritious than it was in 1950, and the bodies eating that food are measurably sicker than the bodies of three generations ago.

What terra preta shows is what is possible when human beings work with soil as terrain. Two thousand years of fertility from a hand-built carbon matrix, on land the surrounding ecology cannot sustain for a single decade. The pre-Columbian people who built it had no peer-reviewed journals. They had observation, generations of accumulated knowledge, and a framework that treated the ground beneath their feet as a living thing to be tended rather than a substrate to be exploited.

What Béchamp showed, with chalk and a microscope and a heat source, was that natural matter contains living units that pure chemistry does not contain. The implication, taken seriously, reorganises the framework. Mineral matter is not dead. The line between living and non-living that mainstream science draws so confidently is not where mainstream science has drawn it. The earth is alive in ways the dominant framework has no language for, and ninety years of treating it as dead has produced exactly the consequences that treating a living thing as dead would predict.

The recovery, if it happens, will not happen through the institutions. It will happen through the practitioners — the lineage from Howard and Balfour and Albrecht and Fukuoka through Gardner and Winters and Austin and Arce — and through the farmers and growers who learn the framework, get the carbon back into the ground, eliminate the chelating poisons, and rebuild from the foundation upward. It will happen one piece of land at a time. It will happen slowly. And it will happen because there is no other way for it to happen.

The living ground is still there, under all of it. It is buried under chemicals, deformed by extraction, drained of its carbon, but it is not gone. It has held terrain on this planet for four billion years. It will outlast Roundup. The question is only whether the people now living will remember in time how to feed it, or whether the remembering will pass through another generation of Iowans drinking filtered water from a river that used to nourish a continent.

Explain It To A 6 Year Old

Soil is alive. Real soil — the dark, rich, sweet-smelling kind — is full of tiny living things, smaller than you can see even with most microscopes, that work together to grow plants. The plants grow because the soil is alive, not because someone sprinkled chemicals on it.

The Amazon rainforest has special black earth in some places that people built thousands of years ago by mixing burnt wood and food scraps into the ground. That black earth is still alive and still grows good food today. Nobody has had to put chemicals on it in two thousand years.

Iowa used to have some of the best soil in the world. People put chemicals on it for ninety years. Now half the soil has washed away, the water is so dirty people have to clean it before they can drink it, and the food grown there has fewer vitamins than the same food had when your great-grandparents were children.

The chemicals kill the tiny living things. When the tiny living things die, the soil dies. When the soil dies, the food doesn't have what your body needs to grow strong. When your food doesn't have what your body needs, you get sick.

The way to fix it is to put the burnt wood back. To stop using the chemicals. And to remember that the ground under your feet is a living thing, like you are.

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