



The images that accompany *Notes from Underground* illustrate three parts of Claire Pentecost's project for Documenta 13.

This series of "sculptural" objects made from handmade soil, or compost, represents units of a new currency, the *soil-erg*, proposed as a replacement of the petro-dollar (coined in 1973 to describe the extraordinary significance of the circuit of value running between a single commodity, crude oil, and a single currency, the US dollar). Like all currency, the *soil-erg* is abstract, but complicated by its material nature. Its undeniable use-value suggests that soil be produced and maintained in a specific context. It is heavy, and because of the loose structure required of good soil, fragile; thus it is not practical to circulate. If currency as we know it is the ultimate deterritorialization, the *soil-erg* is inherently territorialized.

The following drawings are prototypes for unique paper bills. The

drawings loosely conform to three categories: those depicting historical figures that have made critical contributions to an ecological understanding of agriculture; those depicting non-human creatures of the soil-food web; and others picturing writers, philosophers, anthropologists, artists, etc., who have broadened and complicated our understanding of ourselves as part of a wider ecological system.

Can soil be distinguished from real estate? If people can make soil from organic waste, but they have no land, what are the options for growing food in limited space? To address this question, I constructed vertical growing systems outside the Ottoneum and in several other sites around Kassel. For this part of the project I collaborated with designer and philanthropist Ben Friton of the foundation CanYa Love. These pillar forms are simple, inexpensive and easily adapted to dense urban spaces where people are land-poor.

Notes from Underground¹ Claire Pentecost

CONTEXT

I was asked about the seed but find myself dreaming of soil. Seeds are many things marvelous. Most of the seeds that yield food and flavours, medicine, and flowers have been cultivated for generations by millions of people. As a material form of collective knowledge, seeds constitute one of the longest-running open-source systems in history. Agricultural diversity is not simply spontaneous but is the product of centuries of attentive cultivation and unregulated exchange. Designed to travel, the seed is a powerfully compact and mobile medium, and for this reason is easily fetishized for exchange on the market. The privatization of the seed in the form of intellectual property is legalized theft of the commons. In this way, it is alienated from the collective conditions of its production.

Genetically modified seed, the consummate commodity form, is a carrier of the entire corporatized system of industrial agriculture. The complete package comprises the patented seed, the synthetic fertilizer, and the patented herbicide that the seed has been designed to tolerate, all marketed by the same company. The knowledge condensed in seeds is abducted from common hands and obscured in the laboratories and law offices of the corporation. Our surrender of knowledge leaves us in debt to the industry; debt is a way to control people.

The conditions of production of our seed commons are countless seasons of labour and learning. The silent partner in this production is the environment in which the seed comes alive to reproduce itself, the locus of its survival and multiplication: the soil. Like the seed, good soil is the result of a sustained practice, a practice that is social as much as biological.

In a 1969 lecture called "Pathologies of Epistemology," Gregory Bateson upends the supposition that the unit of survival in the evolutionary drama is the species or the family line. Instead,

he proposes, the unit of survival is organism plus environment. "We are learning by bitter experience that the organism which destroys its environment destroys itself."²

The unit of survival is organism plus. In the case of terrestrial plants, "organism plus" means the seed plus soil. What is soil? A mixture of sand, silt, and clay inhabited and structured by a diverse living microcosm. Picture a specific plant that you know and love, a brilliant red maple tree, a blooming lilac, a row of irises.

Did you picture the part that extends below the ground, the rhizosphere where plants and microorganisms communicate and exchange services? Aboveground the plant gets carbon dioxide and sunlight; everything else it needs comes from the soil. All soil is not the same. Distinct mixtures of soil and climate determine what will grow in any given part of the world. The French call this *terroir*: the singular microecosystem of soil, climate, and method that makes one farm's wine, cheese, or sausage taste different from that of its neighbor. This is the site-specificity of cultivation.

ECONOMY

The compost stinks. I have been ignoring the stuff in the bin in the backyard, the bin that I am supposed to rotate on its support more than just occasionally. Though it looks like a healthy enough muck, the smell is unmistakable: butyric acid. This is the same chemical composition that gives sour milk and human vomit their distinctive odors. Some bacterial process in my gut shares a radical intimacy with the bacterial process that has taken over my compost. Dr. Elaine Ingham, my soil guru, would tell me that this is no compost, this is reduced organic waste. True compost is oxygenated decomposition.

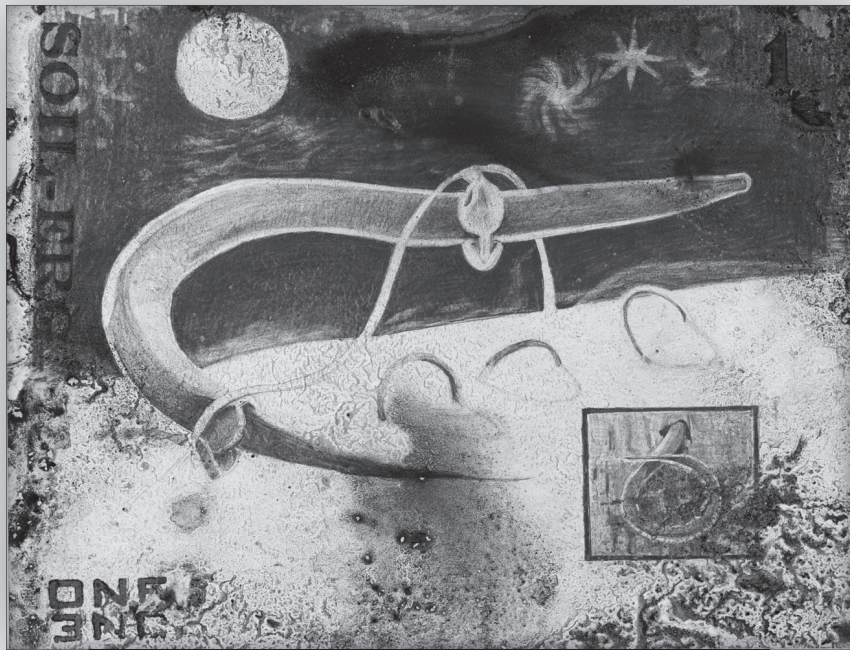
My compost is too wet and has thus gone anaerobic, making hospitable conditions for pathogens. Had I turned it more often, it would have been oxygenated, and the desirable aerobic bacteria, fungi, protozoa, nematodes, and microarthropods



Bee



Donna Haraway



Fungus trapping nematode



Rudolph Steiner

might have flourished. Not only did I fail to turn it, but I carelessly loaded it with nitrogen-rich food waste and neglected to add adequate carbon-rich matter like dry leaves, straw, sawdust, or even shredded cardboard. The balance of these “green” (nitrogen) and “brown” (carbon) categories encourages the beneficial microorganisms that characterize soil.

I am making soil. In my dream, someone asked, can soil be commodified?

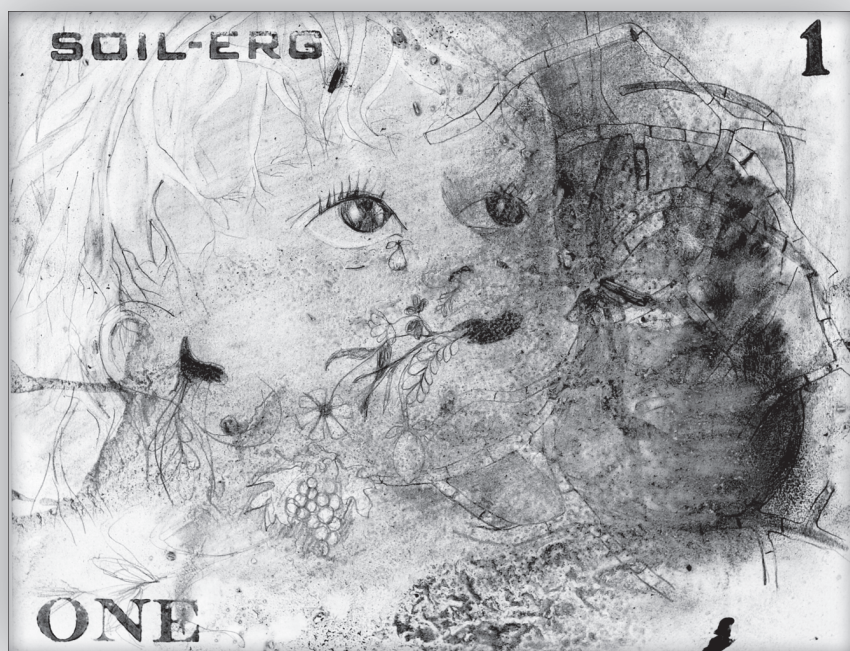
For a moment let’s leave aside the question of real estate and deliberate on soil itself. Separated from a fixed location, soil is not a very convenient commodity. Commodities are all about flow. Soil is heavy by volume and thus expensive to move. Its value is literally in the ground, in a specific territory. But capitalism in its brilliance finds a way.

For things that don’t move or package well, such as climates, experiences, and geographic locations, capitalism extracts the elements of value and converts them to signs that can be circulated in markets. These signs are attached to things that can be bought and sold. How have corporations deterritorialized soil? By detaching from it the bare ingredients necessary to grow plants. The biological cosmos underground nourishes plants, protects them from disease and pests, and discourages weeds that might outcompete them. For these things industry substitutes synthetic fertilizers, pesticides, and herbicides—“inputs”—that purport to replace the labour and knowledge required to maintain soil.

With one application of biocide, living soil is destroyed and replaced by a lifeless substrate dependent on inputs to support plants. Agrochemical inputs are derived from the synthetic nitrogen and the poison gases produced in excess for the wars of the twentieth century. Many of the technologies informing processed food also derive from military research. Imagine that your life depends on vitamins, candy, and continual doses of antibiotics; pricey gizmo foods produced in labs and purchased on credit. The dynamic autonomous knowledge involved in feeding yourself is displaced by debt.



Wangari Maathai



Baby Gaia

The inputs are expensive, but soil ultimately is not. Just as anyone who grows things can save seeds, anyone who understands soil can make it. You can make it by diverting waste streams of nitrogen-rich and carbon-rich organic materials and oxygenating them as they decompose. Perhaps more important, lifeless soil can be rehabilitated with one or two applications of well-made compost or aerated compost tea. It takes a little knowledge and labour, but why deprive ourselves of these pleasures?

ALCHEMY

Soil is undervalued because it is often mistaken for dirt, its zombie carcass. Dirt seems to be everywhere. Dirt is used to express the bottom of the value scale:

Dirt-cheap.

Poor as dirt.

They treat the workers like dirt.

In 1971, when US president Richard Nixon ended the trading of gold at a fixed price, formal links between the major world currencies and real commodities were severed. The gold standard was followed by a system of fiat currencies. However, by 1973, Georgetown University economist Ibrahim Oweiss needed to coin the term “petrodollars” to describe the extraordinary significance of the circuit of capital running between a single commodity (crude oil) and a single currency (the US dollar).³ While not formally fixed to international monetary values, the price of petroleum is the most fundamental value in the world economy. Until the late Saddam Hussein started selling oil for euros, only US dollars could buy it.

Like all extant monetary currencies, the dollar is an abstraction of value, the universal equivalent enabling all other commodities to be traded and circulated on the global market. Money as we know it has an obliterating function: it lets you forget all

the human and nonhuman effort it takes to sustain life.

The new system of value will be based on living soil. The unit of currency—the “soil-erg”—replaces the petrodollar. Made of soil and work, the soil-erg both is and is not an abstraction. Symbolically, it refers to a field of value, but that value is of a special nature: soil must be produced and maintained in a context. It is completely impractical to circulate it. It is heavy, and, because of the loose structure required of good soil, it falls apart. It only makes sense when located in a place. The physical nature of the soil-erg both evokes and denies the possibility of coinage. If currency as we know it is the ultimate deterritorialization, the soil-erg’s value is inherently territorialized.

ANCESTRY

Dr. Ingham obtained a bit of dried mud off an Egyptian mummy. She added water and waited. Under the microscope the bacteria began to wiggle and ambulate.

Bacteria are prokaryotes: single-celled creatures with no nucleus and no internal organelles. They have only one strand of DNA, and that strand is not enclosed by a nucleus. Wherever there is life on earth, there are bacteria. And where there is death, bacteria are there too, recycling the remains into the soil.

If you yourself are not a bacterium, it’s likely that you are eukaryotic, in which case your cells have a nucleus and organelles, e.g., mitochondria and plastids. Eukaryotes encompass all plants, animals, and fungi whose cells have nuclei, from single-celled to multi-celled organisms.

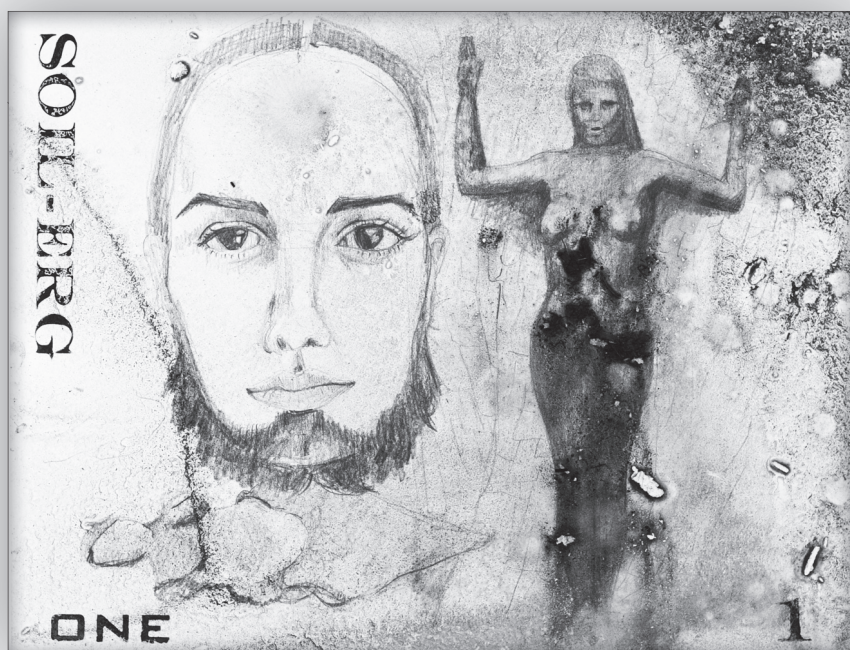
How did we get from the prokaryote to the eukaryote? In other words, where did the nucleus and the organelles come from? Of several contending answers to this question, I am fondest of the one proposed by biologist Lynn Margulis: one bacterium ingested another but for whatever reason was not able to digest it. The ingested bacteria continued to live inside the host and from there performed functions of cycling nutrients, metabolizing sugars, and absorbing and convert-



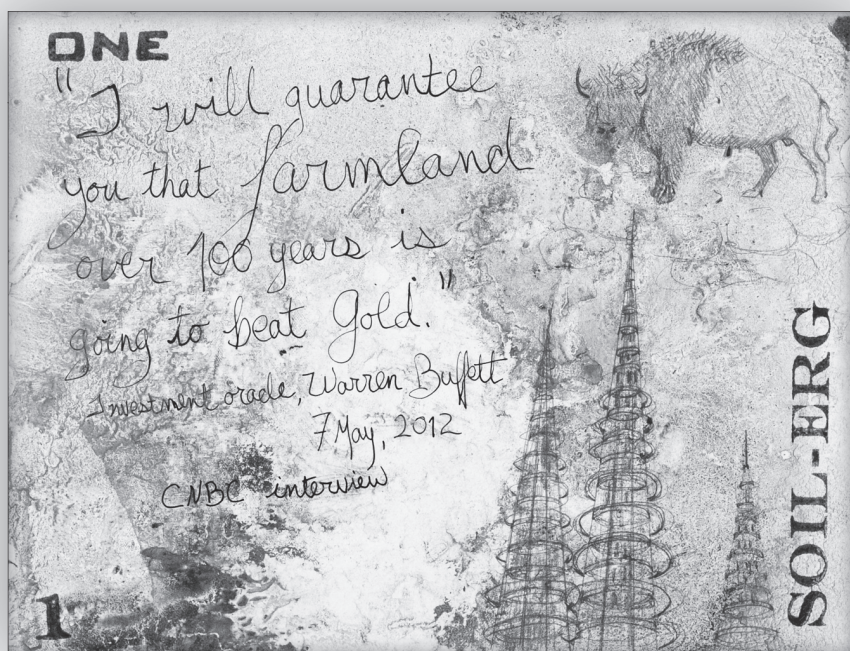
Beuys Pergamasus



Hans Peter Rusch



Anna Mendieta



Warren Buffett quote

ing waste. Although they are parts of a cell that has its own nucleus, organelles contain their own genetic material and function much like bacteria. Bacteria are routinely found living inside the cells of multicelled beings. Margulis writes, "The origin of cells with nuclei is exactly equal to the evolutionary integration of symbiotic bacterial communities."⁴

A primordial form of sex is one organism ingesting but not digesting another. The undigested continues to live, now inside the other: a radical intimacy ensues.

EXCHANGE

Symbiosis is an ecological phenomenon where one kind of organism lives in physical contact with another.

Bacteria live in clusters communicating with one another through molecules for which they have dedicated receptors. All bacteria have receptors corresponding to their own species for intraspecies communication, but they also make signaling molecules that can be received by bacteria of different species, a kind of lingua franca for interspecies messaging. In this way they measure environmental parameters and trigger simultaneous reactions by mixed populations, to the benefit of all. When enough bacteria in a system emit a signal indicating a given environmental state, they will act together, and their actions will be more viable than those of a lone bacterium.

Margulis challenged biological orthodoxy in the mid-1960s by proposing symbiogenesis as the vehicle of innovation in evolution. In symbiogenesis, symbiotic organisms fuse or otherwise share genetic material and functions. From the merger of uni-cellular life-forms with different memories and abilities come new species. Innovation derives from proximity and mingling. Symbiogenesis recognizes that every visible life-form is a combination or community of bacteria. While this view of evolution does not contradict the idea of natural selection, it departs from the more orthodox insistence that random mutation and competition are the drivers of evolution.

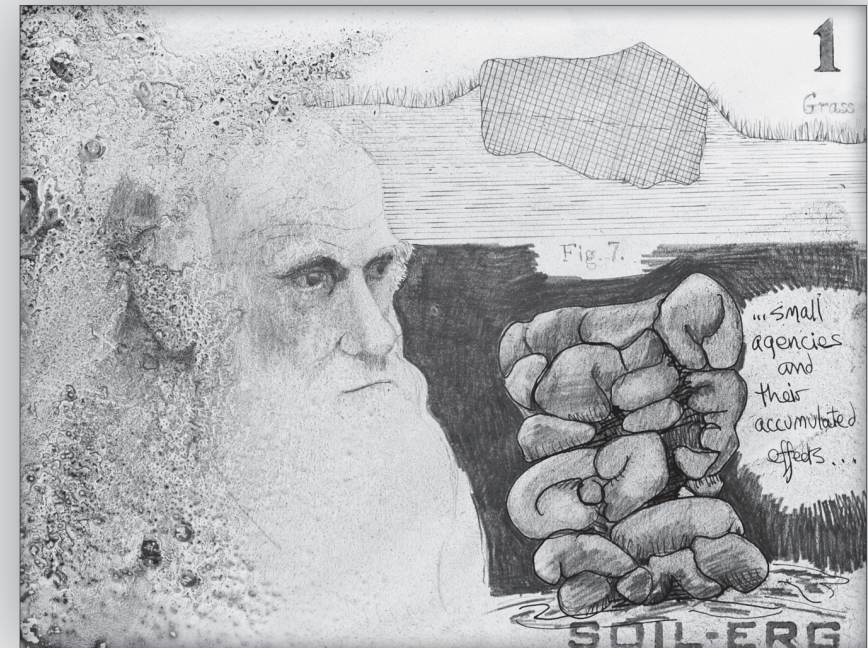
A persistent Social Darwinist vision of evolution legitimates a persistent vision of naturalized capitalism. That economic system is on life support, and whose lives are being burned to support it? In the current movement called Occupy, we come together to explore the unknown fecundity of proximity and mingling. Why wait for leaders when all known authorities can't or won't face the risks produced by a technological society? To whom should we articulate demands when all known authorities have proved their corruption and immunity to change? Why hurry toward a form when the known social forms are exhausted? We are bringing our secret desires and affiliations to the surface. What new life-forms rise from below?

IDENTITY

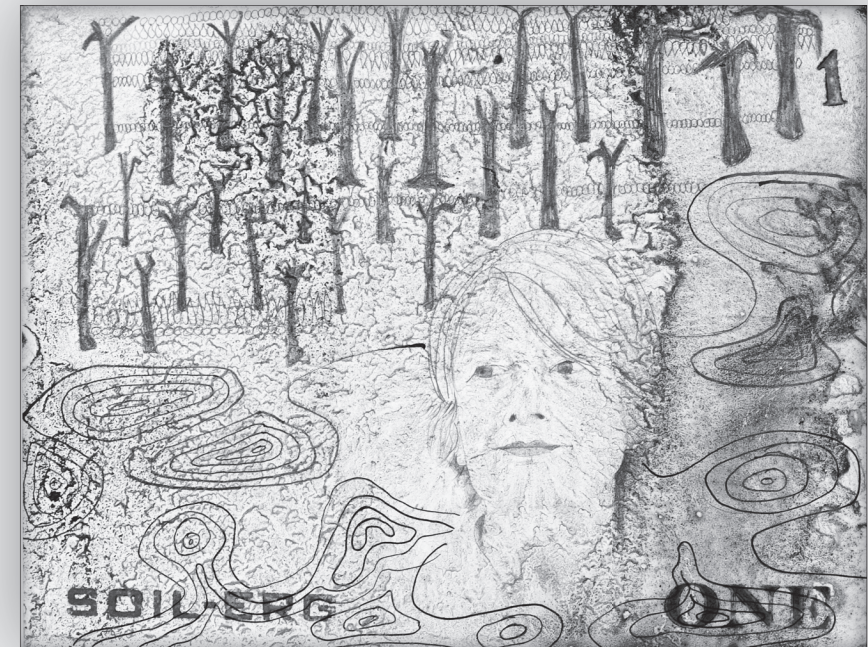
Soil is a persistent community structure. So am I. What we call the human body is composed of ten times more bacteria than human cells. They live on the skin, in the gut, in every orifice, and I don't know where else. Many of these bacteria are "commensal" with us. When two species live in commensal association, one species benefits without harming the other. Commensal can also mean "sharing a table," from the Latin *com* (together) + *mensa* (table). Of course, the world is also full of disease-causing bacteria, but the more neutral and beneficial microbes crowding your table, the fewer seats there are for pathogens.

The metabolic activity performed by bacteria in the human gut is a mutualistic symbiosis in which both symbionts have something to gain. Besides making our digestion efficient and painless, intestinal bacteria train and otherwise help direct immune cells. Because of the scale of their contribution, the gut biota is equal to that of a virtual organ; the community of intestinal microbes can be called a "forgotten" organ.

Up to 500 different species of bacteria have been found on the skin, and many of the smaller populations have only been met on a single human host. It may be that we each bear



Charles Darwin



Isabelle Stengers



Farmer



Félix Guattari and Gilles Deleuze

a unique bacterial signature. Most of the genetic material in the human body resides in our bacteria. There was disappointment in the air when the human genome weighed in at less than 30,000 genes (it has since been downsized to around 23,000). But the Human Genome Project didn't count our bacterial genes, which number about a hundred times that. How does the human microbiome relate to the human genome? The strangers in our bodies may be a larger factor in our identities than our own cells.

Perhaps we are not the subjects of the story at all. And who are we anyway? We are armature for a more populous, more diverse community. Perhaps the bacterial communities that are us share a radical intimacy with the bacterial communities that are soil. And when soil is poisoned, the bacterial we suffers. Reality is more queer than not.

CONVIVIUUM

Bacteria also reproduce by fission, simply splitting into two individuals. It seems, however, that unless they also exchange genetic material via conjunction with others, the resulting colonies slowly grow old and die. Like us, bacteria say, "I want to live and I don't want to die alone."

I added a lot of carbon to the compost in the form of shredded cardboard, which comes easily out of the incessant waste stream of packages. I've continued to turn the mix to oxygenate it: a clean earthy fragrance signals the changing constitution. I prepare a sample to ponder with the microscope.

A million vibrating cocci and bacilli glide about this single drop of compost-infused water. In the excessive nitrogen of the kitchen waste, bacteria numbers are booming.

Elegantly penciled serpents thrash in the sea on the glass slide. The shape of their mouths tells me that they are bacteriophagic nematodes. In every field there are translucent eggs with the small end bitten off, some with beautiful interlocking scale patterns. Testate amoebae make for themselves a protective shell or "test" (Latin: *testum*, an earthen pot),

either by secretion or through the agglutination of foreign material—particles of calcium carbonate or silica.

Small shadows move erratically through the field like drunken ghosts. Flagellates.

Here and there a burly shape-shifter edged with delicate fluttering eyelashes. Ciliates.

Rarely, an armored bulk looms in the eyepiece, spiked limbs motionless or flailing silently. Microarthropods.

The microscope verifies animism, the theory of the universal animation of nature.

ECOLOGY

Are these organisms good for my soil? Dr. Ingham replies: “Standard ecological answer: ‘It depends.’” In this context, it depends on what I want to grow. The soil I want to make (for growing most vegetables) has a good balance of bacteria and fungus, but fungal food is more carbon-rich than what I have provided, so my sample is missing brown and amber strands of fungus. I might need a handful of soil from a forest floor to inoculate the brew.

Soil dominated by bacteria selects for the fastest-growing, most opportunistic species, those we call weeds. As weeds die and the earth collects dried organic matter, more carbon-rich material accumulates, setting the conditions for fungal growth. Ecological succession is a process of increasing levels of fungi in the soil. Newly disturbed earth is teeming with bacteria. Old-growth forests have millions of miles of mycelia (fungal strands or hyphae) woven into their roots. We know them by their fruits, the mushrooms.

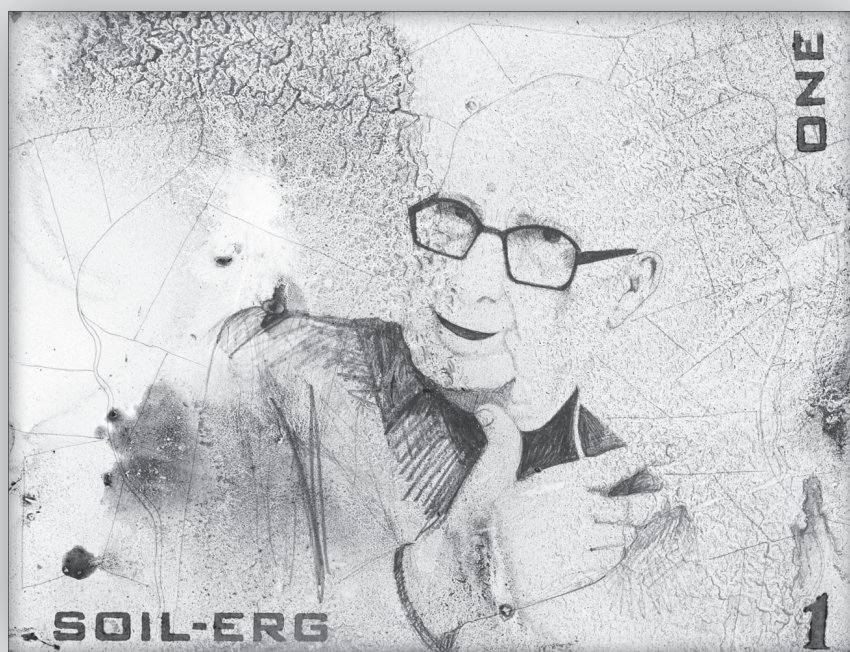
Mycelial hyphae grow in branching filaments that breathe, retaining 60 percent of the inhaled carbon dioxide to build the walls of their advancing pipes. Mycorrhizae is a mutually beneficial association of plants and fungi: mycorrhizal fungi need plants, which in turn do poorly without their counterparts. Soil that houses mycorrhizae—the plants, the fungi, and their interactions—sequesters astonishing measures of



George Washington Carver



Gerrard Winstanley



Hans Müller



Coccoidea Margarodidae

carbon. Killing fungal networks with plows and pesticides releases carbon into the atmosphere. These are not trivial amounts. Bare soil disturbs climatic harmonies.

Mycelia respire, filter, digest, and construct. Paul Stamets, ardent teacher of all things mycological, calls them “externalized stomachs” and “externalized lungs”...but of what?⁵ Of the unified geobiological system that regulates life on the planet? The sentient supersystem that some call “Gaia?” Ecology begets animism on a grand scale.

Mycelia transport water, nutrients, and messages in the form of chemicals from one tree to another, from one plant to another. Stamets refers to these meshes as extended neurological membranes. Not unlike the Internet or our brains, if one branch is broken, there are numerous alternative pathways for moving goods, services, and information.

One is tempted to call mycelia the brain of the earth, or its nervous system. But the earth is more vastly complex than a human analogy can contain. The life cycles of ten million living species all consuming energy and releasing by-products are coordinated in a system that collects energy from a star and recycles its own waste. The activity of life is what created the atmosphere of earth and now regulates it. We and our atmosphere evolved together.

CANNIBALISM

We are ready to talk about real estate now.

Since the economic crisis of 2008 was experienced by many parts of the world as a food crisis, many governments, corporations, and investment funds are buying up land in Asia, Africa, the Americas, and Eastern Europe for industrial agriculture and other profit-driven ventures. The crisis sent transnational elites looking for new places to put their money, and land appears to be the designated safe haven. Local governments collude with investors under the rubric of “development” and “progress,” allegedly for the benefit of peasant populations, while armed forces evict these same

populations—small farmers, indigenous people, ethnic minorities—from the villages and fields they have inhabited for generations. The World Bank and regional development banks draft investor-friendly policies that grease the wheels for extractive industries. This is called land-grabbing.

One way or another, capitalism is colonialism. If the money can't find a new resource to feed on, it will reformulate an old one. Capitalism offers the earth a global system that feeds on itself and doesn't recycle its own waste. The infantilizing fantasy that preys on us is that of never having to acknowledge limits.

"Nature" is not a metaphor for anything. Rather, it is a protean field where we stagger toward understanding true diversity, how we want to live, what kind of world we want to foster. When one bacterium ingests another, evolution is trying out new combinations. When humans recklessly consume the livelihoods and cultures of other humans, monocultures are advanced.

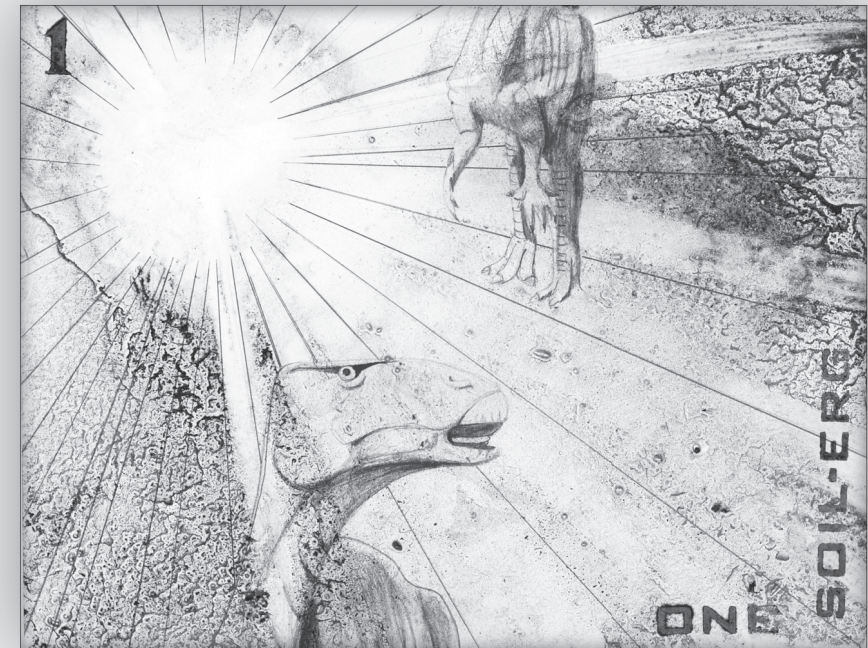
ART

I am dreaming of the soil-erg. I am dreaming of an economic system that is a coordination of countless economic systems of diverse fields of value recognizing finitude and regeneration. But this does not sound like dream language. This wants to be real. ○

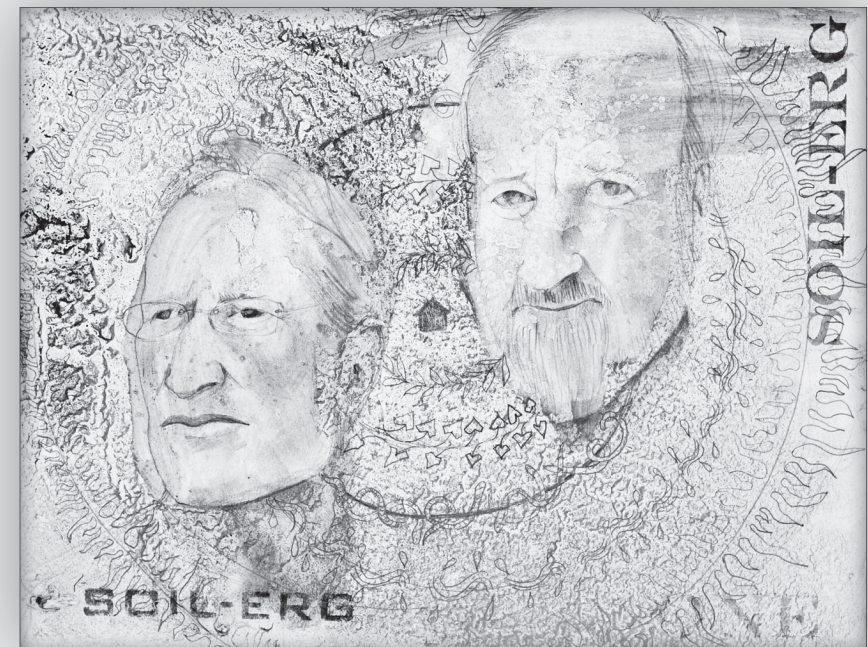
In memoriam Lynn Margulis, March 5, 1938–November 22, 2011.

ENDNOTES

- 1 This text was previously published as part of the Documenta 13 publication *100 Notes—100 Thoughts*. See Claire Pentecost, "Notes from Underground/Notizen aus dem Untergrund," in *100 Notes—100 Thoughts/100 Notizen—100 Gedanken N°061: Claire Pentecost* (Kassel: Documenta/Hatje Cantz Verlag, 2012).
- 2 Gregory Bateson, *Steps to an Ecology of Mind* (New York: Ballantine Books, 1972), 483.



Iguanasaurus



Dave Holmgren and Bill Mollison

- 3 See Ibrahim Oweiss, "Petro-Money and the International Monetary System," *Middle East International* 39 (September 1974).
- 4 Lynn Margulis, *Symbiotic Planet* (New York: Basic Books, 1998), 38.
- 5 See Paul Stamets, "Six Ways Mushrooms Can Save the World," *TED Talk*, March 2008, http://www.ted.com/talks/paul_stamets_on_6_ways_mushrooms_can_save_the_world.html.

BIO Claire Pentecost's work engages diverse strategies: collaboration, research, teaching, field work, writing, lecturing, drawing, installation and photography in an ongoing interrogation of the institutional structures that order knowledge. Her work has long addressed the contested boundary between natural and artificial, focusing the last 14 years on food, agriculture, and bio-engineering. Pentecost was a presenting artist at dOCUMENTA(13) in Kassel, Germany, and is represented by Higher Pictures in New York. She is a Professor in the Department of Photography at the School of the Art Institute of Chicago and often collaborates with Compass in the Midwest Radical Cultural Corridor.

