

Lea

LEONARDO ELECTRONIC ALMANAC

VOL 17 NO 1 A collection of articles, reviews and opinion pieces that discuss and analyze the complexity of mixing things together as a process that is not necessarily undertaken in an orderly and organized manner. Wide open opportunity to discuss issues in interdisciplinary education; art, science and technology interactions; personal artistic practices; history of re-combinatory practices; hybridizations between old and new media; cultural creolization; curatorial studies and more.

Contributions from

Frieder Nake, Stelarc, Paul Catanese

and other important cultural operators.

M I S H
W V 2 H

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ABSTRACT

Complex systems require, for their full description, a language commensurate in complexity. The application of mathematical language to systems such as ecosystems or ritual systems demands a psychological distancing in order to apply the math in the first place. The resulting sensorial disembodiment precipitates yet another flavor of the mind-body separation.

by

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Jerry's storefront is a mess. Stuff is scattered in the window – an axe, woodcarving knives and gouges, leather scraps, a couple of sun-bleached souvenir t-shirts, all for sale. There's a bench piled high with magazines and old books that he pulls in at night against the weather. It props the door open during the day, and there's a workshop in the back. Jerry's a master woodworker who stands by his craft for life, be it a new cabinet or a repair. He'll tell you he's been living up North here for three decades, and he'll tell you also that he's been battling entropy ever since.

When his son was eight years old, Jerry was taking courses at the local college. Chemistry among them, he'll tell you, but no matter how hard he tried he just couldn't wrap his head around it. Jerry would slug

away at the material every evening after dinner. One day his son asked him what was up. "Entropy," replied Jerry, "entropy." "Entropy," repeated his son, but it wasn't a question. "Yeah," said Jerry, "I just don't get it." The kid pondered for a minute and pointed to the family pickup out the window. "You know our truck, Dad?" Jerry followed his son's finger to the clunker and nodded. "If entropy didn't exist," explained the boy, "our truck would all by itself turn clean and neat and shiny and all brand new."

Jerry's got me thinking. Specifically, he's got me thinking about the Grid, the certainty of rectilinear space, of north-south-east-west. When British explorers came to the New World, they straightaway christened it with the Grid. Want to head west, young man? Just follow the compass clean and straight in that direction. The land's contours, its waterways and gorges and mountains, its eloquence in communicating paths of least resistance, were all ignored as unessential to understanding, appreciating or traveling it. No surprise that centuries later John Hildebrand suggests, "Perhaps we have lost the language to describe a landscape beyond the terminology of real estate brokers."

I'm a scientist trained to study the physical world through the language of mathematics. And, like many

others with that background, I was eventually drawn to biology and the workings of the Earth's ecosystems. But to genuinely hold the living land – to pull it back into our heads and hearts – any descriptive language for it must match in its complexity the complexity of the land itself. It's taken me a long time to learn this. Because scientists, like real estate brokers but perhaps more unwittingly, also celebrate the Grid. I'm trying to understand our excuses for that.

Thinking about Jerry has also got me thinking about René Descartes. Such musings *always* point in his direction. Had Descartes played soccer he might have quipped, "I play soccer, therefore I am." Or, "I take a tumble in the hay with Marie every Tuesday afternoon, therefore I am," if that were indeed the case. But the man was a philosopher and so, "I think, therefore I am."

"More absinthe, René?"

Descartes tilts his glass and Jerry pours them each another hit of the green liquid.

"Merci," says the philosopher. He's pondering a wealth of new information. "Tell me again, mon ami, this entropy idée of which you so eloquently speak ..."
"Well that's how it is, man," explains Jerry, "that's how it goes. Entropy rules."

While completely unconvinced, Descartes nods to indicate his attention to the argument. He'd never heard about entropy until bumping into the woodworker in

this Parisian café and bar. Descartes' eyes shyly follow the admirable bottom of a woman as she slips off her stool.

"Look, everything just turns into slosh," Jerry insists. "What order? More like disorder. What clockwork universe? You're nuts, amigo."

Descartes contemplates Jerry's features. In any case, the well-groomed Frenchman thinks to himself, my facial hair would never degenerate into such travesty. "Non. Ce n'est pas possible," he retorts. "I am not, as you say, nuts." René pulls hard at the absinthe and counters. "There is a rational system for thought and for the Heavens. A discernible and permanent celestial precision, so to speak. This – and he swept his arms to indicate all of it, the café, the street, the city of Paris, Europe, the stars – this never winds down."

"Why the hell not?" Jerry responds. "Maybe some of it does, some doesn't," he reckons as he reaches for his new friend's empty glass.

Another dialogue unfolds under the café's decaying rain gutter. With the force of a tiny recoiling rifle, a spider attacks a huge beetle again and again. Shiny brown-black in the streetlight and crying out in desperate chirps, the beetle fights for its life with two legs not tangled in the web.

Descartes insists on picking up the bill. Tomorrow he'll visit the Musée de l'Homme where his skull is preserved for eternity. "Don't need to see that," Jerry responds when asked to come along.

—

There is something serious here, and I'm grateful to David Abram's extraordinary *The Spell of the Sensuous* for this and so many other insights. Descartes' senses – his sight, his bodily and sensual connection to the world – told him that the sun rose to bring the day.

Its daily travels took it across the sky. But Descartes' intellect – his science via Copernicus and Galileo – assured him that his senses were in complete error. The Earth was doing the moving, not the sun. And so, for Descartes, as for many Enlightenment thinkers as the Sciences took hold of their imaginations, an essential tension divided the senses and the mind.

The vying demands of polar dictates can result in creative release of that tension. Competition between entropy and energy, the former pushing to disorder and the latter to energetic minima, provides scores of familiar examples of such release, like ice melting to a different state of matter. Descartes' resolution to his own confrontation with two alternatives – mind or body – was unilaterally in favor of the mind's supremacy. A creative third solution was not his to offer. He dismissed as inessential the senses and body.

Not too many miles from Jerry's store, night comes to a lake as I again wonder what rendered the land so vacant to the Western soul that our longing led us to a transcendent God. As part of the puzzle, it starts to make sense that people when exiled must take their gods with them in their wanderings. It helps to have a god no longer tied to the land. A god no longer embodied with the geographical, faunal or floral features of a particular and unique place. A hidden, portable god: relegated and withdrawn to the everywhere heavens.

Perhaps this propelled the symmetrical believe that all things worth knowing are hidden. Why shouldn't all longing turn us to the starry night and to the invisible, away from the forests and rivers? Our fascination with things unseen and unfathomed by our unaided senses have illuminated the extremes: from the atom and its even smaller constituents to the black holes of space-time and the dark matter holding it all together. We

practice a science of the hidden. And its most sublime language is that of mathematics.

Physics, specifically theoretical physics with its extraordinarily sophisticated mathematical apparatus, is considered the crowning achievement of the scientific enterprise. Even sequencing the entire human genome pales compared with the genius coalesced into fundamental equations, an obvious example being $E = mc^2$. Encapsulating the universe so simply is profoundly mind-boggling and exquisitely seductive.

Mathematics is a wonderful thing, elegantly explaining both the massive cosmological and the invisible atomic and molecular worlds. It can hold perfectly the story of the physical universe: A one-to-oneness between language as descriptor and the described, the language being just right. Not surprising then that math is hailed as the music of the spheres, the language of the cosmos and, if you have the bent in that direction, the language of God.

Mary Oliver recalling Leo Frobenius in her *Blue Pastures*: "It was first the animal world, in its various species, that impressed mankind as a mystery, and that, in its character of admired immediate neighbor, evoked the impulse to imitative identification. Next, it was the vegetable world and the miracle of the fruitful earth, wherein death is changed into life. And finally ... the focus of attention lifted to the mathematics" of the heavens.

And mathematical logic is assumed by scientists to animate the universe equally brilliantly at all levels of its organization, from the profoundly microscopic to the astronomically cosmic and everything in between. It's this in-between place that troubles me as we run Frobenius backwards by bringing the mathematics of the heavens to the vegetable and animal world – when we bring that compact language and its clean

logic to things far more complex and intertwined than mathematics was ever meant to describe. A feeling of profound rightness – of beauty – emerges when mathematical analysis engages the physical world, the world of chemistry, biochemistry and molecular biology. But when that same mathematical thinking is turned upon the land, onto ecosystems and their integral unity of plant, animal, earth, water and sky, there needles in me the taste of the manufactured. Shouldn't it strike us as odd that a language constructed to quantify the mechanical sweeps of planetary motion is asked also to hold the complexity of the biosphere? I'm not so thrilled to place the living and the dead in the same box.

Descartes' wildly successful coordinate system, his mutually perpendicular axes of rectilinear space, made possible the mathematical description of the physical world. Without it, Newton's classical physics, Einstein's theories of relativity, and quantum mechanics would have been impossible. It's also of note that Descartes once spared an opponent's life in a duel. But he didn't tumble in the hay with a woman named Marie. Her name was Helène and she lived in Amsterdam. Perhaps it's not worth speculating whether he'd re-envision his "I think, therefore I am" had their daughter, Francine, lived past the age of five.

—

Jerry and René Descartes are contemplating the contours of the latter man's skull.

"René, let me get a picture of both of you, eh?" says Jerry. "Just turn a bit more..."

Jerry figures he'll pin the image up in his shop. Be a great conversation piece, maybe Photoshop-in some antlers. "Hey, René!"

Understandably absorbed by the skeletal remnant of himself, Descartes is slow on the uptake. "Both of us?" he asks. "A portrait of you and me, then?"

“No, you and your skull, man.”

“Ah, oui!” The ramifications delight the philosopher.

Jerry fiddles with the camera's settings. “Yeah, that's it. Step to the left, turn your head more ...” Click!

Later, the ambassadors of chaos and order are back at their café. Before they start drinking, Jerry says he'll pay though the dollar sucks against the Euro. Better that than letting René dig into his money belt for those gold coins again, which the slippery bartender had accepted as appropriate currency the other night. “This machine” – Descartes is examining the marvel that is Jerry's camera – “is quite extraordinary, non? It paints with light, you say?” he asks.

“Yeah. It's all right.”

“And it is ... reliable? Yes, that is the exact word: reliable.” Jerry shrugs. “Yeah, for now. It'll go to crap in a year or

two.”

“Ah, your entropy again, yes?” René hands Jerry back the camera.

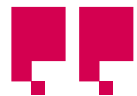
Built-in obsolescence was never part of Descartes' world, Jerry realizes. So he simply shrugs again and says, “Nah, it's just made badly.”

The philosopher bolts up and knocks back his chair.

“Voilà! There we have it!” Descartes gulps triumphantly from his glass. “All imperfections are simply our own,” he continues. “No product of the truly rational mind can be flawed, and had the design and construction of this instrument been well executed ... it would have been perfect.”

Jerry shakes his head. “It's all just an entropy blitzkrieg, man,” he insists.

“Non. It is all irrefutable reason in its mathematical glory.”



Where lies the delineation between a beaver and the rest of the ecosystem? Does the beaver include that tree being gnawed at? And when the tree falls, must we consider the newly diverted rivulet of water that destroys a nest of baby field mice?



Clockwork stalemate, and they click their glasses to it. On a cloth napkin, Jerry's sketching a new design for a dresser and the alcohol loosens Descartes' memories of his dead daughter.

Somewhere a dragonfly snatches away a mosquito fallen into a cool lake just as a fish rises for it.

—

Mathematical models were first introduced to describe predator-prey dynamics in the 1920s. And so, the biology of the food web, the who-eats-whom-of-it, expressed in the language of physics.

A famous example features the snowshoe hare and Canadian lynx duo. I've never seen a lynx chase down a hare, but I can write down equations for the hunt. We practice a portable science done from a distance: its equations are created and solved far from the phenomena that motivated their creation. It's as if the two, the mathematics and hunt, are not living in the same room. And distance – whether spatial or by severing my fundamental identification with the hunt, either as a predator or prey – is absolutely necessary for me to write down those predator-prey equations. That distancing must be forced upon me – precisely in order to do the science without acknowledging the conflicts between my senses and intellect. Without that distance, I would too clearly know that I'd reduced something so vibrant, powerful, and profoundly archetypal to a sterile abstraction. Without that distance, I wouldn't be able to write down the equations. The mathematics and the hunt *cannot* live in the same room.

In of itself, mathematical analysis of predator-prey dynamics is beautiful, rich and challenging. But when language in its own richness doesn't match the complexity of the phenomenon being described or communicated, we're left with caricature. All that I

am saying is this: Our scholarship needs a lot more wildness if it's to meet the wildness of the living world anywhere near halfway. A living organism is embedded as both predator and prey into its surroundings of other organisms – it eats and is eaten. Other levels of organization network the organism and the land through biogeochemical processes and their poorly understood feedback loops. Moreover, all living things and their evolution over eons have reciprocally modified and are modifying, sometimes dramatically, their environments. For example, by using hydrogen sulfide emitted from deep-sea vents as an energy source, the tubeworm *Lamellibrachia luymesii* detoxifies the local environment thus making it hospitable to other life forms. But the tubeworm itself survives only through an intricate symbiotic chemical feedback loop with bacterial consortia, which in turn support the nutritional needs of several species of marine animals.

The problem is that the deep-sea tubeworm *L. luymesii* cannot be teased away from the whole; its *relational* ties to the rest of the ecosystem cannot be withdrawn without violating the system's inviolate self. Or a little closer to our own warm, fuzzy, mammalian selves: Where lies the delineation between a beaver and the rest of the ecosystem? Does the beaver include that tree being gnawed at? And when the tree falls, must we consider the newly diverted rivulet of water that destroys a nest of baby field mice? How about the *Giardia* I suffer by stupidly drinking water from that new stream? The boundary between beaver and surroundings is fluidly dynamic. Or, really, there is no boundary at all. In an ecosystem, everything revolves around everything else. There is no center. However, the thermodynamic mainstay of energy and matter flows across system-surrounding divisions was not designed for that kind of complexity. But to practice science, one must focus somewhere. Otherwise, how to begin?

An ecosystem's dimension of wildness spirals the imagination. And wildness is the dimension most absent from mathematical language. If mathematics as we've come to understand it over the centuries could contain the complexity of the biosphere, my senses and intellect wouldn't be strangling each other. The models wouldn't smack like bloodless footnotes on the primary text. To pull out of an ecosystem that part reducible to mathematical analysis – for one can always do that – is the fake comfort of understanding a great deal about the bath water in which the conveniently forgotten baby was bathing. The language we cast over the Earth, with its animals, and plants and rivers is not its own.

And so, to remain felicitous to the scientific enterprise, we've pulled ourselves from the Earth's wild energies. Sadly, our abstracted language of mathematics with its terrific intellectual rewards made that all the easier. Like Descartes before us, we've fashioned an either/or choice: Either abandon the language or disembodiment ourselves from the living land in order to do the science.

—

In *Totem Salmon* Freeman House describes the salmon ceremonies that spiritually charged the Klamath River and its tributaries. Separated from each other by both language and long miles of river, the Yoruk, Hupa and Karuk people there developed an exquisite system of ritual commensurate with the land's complexity and their own collective livelihood.

With the annual return of king salmon to the Klamath, the Yoruk living near its mouth took a single symbolic fish. Spiritual elders ritualistically consumed this first salmon. The ensuing ceremonies established a firmly proscribed delay on general fishing, thereby allowing the salmon to work their way upstream to spawn and

to feed the Hupa and Karuk. In the meantime, Yoruk runners set out for Hupa villages with news of the salmon's return. After ten days of prayer following the arrival of salmon to their stretch of river, the Hupa started fishing. Furthest upstream in the Salmon River tributary, the Karuk, also informed by runners, re-treated to the surrounding hills for thanksgiving while the elders conducted their ceremonies. Only then did they return to fish the river. The tiniest details for constructing fishing dams were encapsulated in ritual.

The confounding dimensions of human imagination notwithstanding, I'm wondering about the role of self-organization in establishing ritual. Self-organized systems are not engineered; they achieve their dynamical patterns without foreknowledge or recipes on the part of any boss as to the final outcome. As I sit with my laptop very far from the Klamath, far in geographical and historical distance, I find myself thinking that I can model this thing. The whole enchilada, I mean, salmon and people.

At first it seems that tackling the actual harvest, the percentage of salmon taken from a year's run, would be simple enough. But that percentage must optimize for maximal salmon return the next year while nourishing people this year. So, the equations couple fish and humans from the get-go. Then there's the lag factor. How many days do you wait after the first salmon appear before harvesting? OK, I can deal with that. But how far upstream do salmon travel in that time? What fraction spawn successfully? Gotta optimize for the lag factor as well. Hmm. OK. Best case scenario: My model gives the harvest percentages and lag factors the Yoruk, Hupa, and Karuk established through self-organizing exchange with the land and with each other.

Man, it's pulling me in. But the thing's getting complicated. I need another espresso to keep rolling.

Oh, why the hell not? I'll just transport myself in a time machine to the Klamath River 150 years ago. Notebook and pen in hand, I'll follow the progress of salmon and ritual as both travel entwined upstream.

—

At the water's edge near a Karuk village, I cool my feet in the river. Salmon touch against my skin. My notebook sits at the ready by my side in case there's anything else to jot down. But I think I've got all the field data I'll need. The village is at work, fish are smoking on willow skewers and the holy gift of food animates the air as several men dismantle the fish dams. My sleek laptop is tucked with plenty of padding in an old-school canvas backpack along with a solar-panel battery charger: I've come prepared to develop and work the mathematical models. A little blue and black butterfly like batik cloth somersaults around my head.

René Descartes and Jerry are with me. Both are wearing dark sunglasses against perpetual hangovers. We finish off the fish we've been munching. René's downright ravenous.

"The peasants are working hard, non?" he says pointing to a group of women a ways downstream. "Don't be such a bonehead," Jerry mumbles.

"Merde," objects the philosopher, "I was only sympathizing with their labor." He wipes his nose on an embroidered handkerchief and swats at a fly.

"Jeez, I need to get my sorry ass back home," says Jerry, which is exactly what Descartes and I are thinking. Jerry doesn't do too well far from his tools and craft. Damn, I used to like these guys. Even Descartes seemed human enough when sauced. "Can you two just shut up a minute?" I bark, even though nothing's been said till now.

Two guys walk into a bar. One's a devotee of reason, the other of chaos. But the joke's on me. Straddling

their extremes, I'm looking for that third solution but am armed with a language unyielding to it. What's a scientist to do? I'll 'fess up. These two bozos were supposed to figure it all out for me.

While the company isn't, the salmon's good. A young Karuk man walks over to offer us another and goes back to his work. So much for keeping a low profile. We wolf down the fish.

"You know," I say for no reason at all through my salmon-full mouth, "there's like a hundred billion neurons in a human brain." While Jerry just nods, probably knowing that already, Descartes stares hard at me. The batik butterfly settles on a nearby sun-hot rock. The three of us, like idiots, simultaneously extend fingers to the creature. I'm thoroughly delighted as it cautiously walks over and chooses my perch. It uncurls its long tongue and probes, possibly for sweat and certainly not because I'm the best man here, no matter what I'd like to think.

René's pacing about, scratching his thinking head and holding it between his palms from the exertion. "Ah!" he exclaims. "My skull then, these neurons... that is what fills its cavern? C'est magnifique! Those neurons together becoming mind!"

"Easy there, cowboy," I say, "sit down."

"One hundred thousand neurons ..." René continues his mulling, ignoring me.

"Billion," I correct him, "billion. Not thousand."

"Ah! One hundred *billion*! Mon Dieu!"

I inform him that a chunk of soil has that many microorganisms.

"But ..."

"But nothing," Jerry finishes him off. "Sit down already," he says.

"Mes amis," begins Descartes, but instead he shakes his head at our American 21st century rudeness and starts walking upstream along the river.

"Some nut-job, eh?" Jerry says to me.

“Well, you started this,” I remind him.

“What? What’ya mean?” he demands.

“Yeah, just look back to the start of this story. In the beginning was chaos... you know what I’m talking about.”

Jerry stands up. “I’m just a woodworker, man,” he says.

“That’s all. I make things with my hands. I like doing that. I’m good at it. Spare the crap personality you got slapped on me, capiche?” He heads upstream as well and catches up with Descartes.

A quick breeze agitates the reeds by the water, and Jerry runs his hands along their tops. He and René continue their stroll upriver. I lie back to exhale. We three don’t sit too well on the land. I’ve got work to do though and, sitting back up, I take out my laptop and turn it on. That burst of I’m-Booting-Up music doesn’t sit too well on the land either.

I keep an eye on my antagonists. They’re maybe a couple of hundred yards away, René and Jerry, and they’re talking and gesticulating and shaking their heads. Probably just arguing again, I figure.

After fiddling with my computer for a few minutes, I shut it down and slip it back into its pack. Wanted to check the news before I got down to work. Forgot that there’s no Internet. What an odd pair, Descartes in his seventeenth century finery and Jerry in jeans and a flannel shirt though it’s way too warm. I stuff my notebook and pen into the pack as well. What are those two so excited about?

I lie back down. What I want so much is to love this – the river, the salmon, the butterfly, the human rituals – to love it all easily, naturally, and without turning my longing into another project for personal growth.

But my mind is telling me to model the damn thing already, to write down the equations. It’s trumpeting that everything remains a void until stamped with its cognitive seal of existence – even as my body knows that any equations I’d scribble here by the river, any computer codes I’d attempt, would wrong the river, the salmon, and the rituals I’ve witnessed. My body lives in a Diaspora of the mind’s brewing. Oh, René, what have you and your buddies done?

Something’s going on. René’s on his feet and very excited. I stand up for a better look. From his satchel, he yanks something out, looks like his notebook from here, and he frantically shakes the rest of the bag’s contents onto the ground. What’s he looking for? A quill? Ink? Whatever it is, he can’t find it. René flings his arms up in desperation, and I start off upstream at a run.

Jerry grabs a pen from his pants pocket. He and René high-five to it like the world’s best buds. What the – ? Composing himself with a single deep breath and cracking his knuckles, René writes something in his notebook. Can’t be more than a sentence or two. He hands the book to Jerry who nods and punctuates their collective enthusiasm with another high-five. The bastards. And before I start begging to see what’s written, René and Jerry turn into fish to join the salmon run.

—

Morning comes. I look at the river. I look at my laptop and notebook. I time-transport them back to my university office in the future.

When I get back there myself, I’ll work the equations in air-conditioned splendor. There, in my office, my intellect will be shielded from any sensual embodiment in the land. My mind will deny the mutinous complexity of my body’s experience. There, in my office, with hardly a nod to its obvious wildness and creativity – talk of self-organization notwithstanding – I’ll demand that the entire biosphere fold neatly under the vestigial mechanistic paradigm to which an atom or chemical reaction is amenable.

Or better yet, I’ll work the equations in a café. There, I’ll forget the land as the equations and computer code smoke and mirror me with their own special seduction. I’ll model the thing with well-mannered equations and saddle it with formulaic and algorithmic computer codes to explain its dynamics. I’ll corral it into reproducible and therefore ultimately predictable outcomes. I’ll snuff the thing of its wild glory.

And I’ll sip espresso with my computer and reminisce over vague memories of salmon, knowing fully that a science of the embedded won’t be forthcoming under the fluorescent machine-buzz of electric lights. All my longing for a new language will retreat to subterranean consciousness, nagging me no longer.

I’ve already got the taste of espresso in my mouth. But it’s not quite time to go home. I stay by the river and catch another fish, hoping it’s not Jerry or René.

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Nothing’s changed in my office. Big surprise. There’s my laptop and notebook. Guess I had good aim. Air conditioner’s full on. A stack of mail, probably tons of email to delete. It’ll all wait. The raven feather I brought back sets off nicely against the brown fake-wood furniture.

As I’m about to kill the office lights and head out to the café, I spy a piece of paper resting on my chair. Obviously torn from a notebook, the paper’s of heavy grade and well made, with a greenish stain like grass on one corner. Two sentences are written on it in ballpoint but with a neat flourish of elegance. One’s in French, the other is its English translation. I take the notebook page with me. It reads *Discourse on the Intelligence of Soil*.

Q. E. D.



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