

### **Huysmans' Tortoise**

How things were a decade ago: The largest rain forest of our planet abides in the Amazon Basin, a tenth of the entire world biomass. It is one of the last great frontiers on earth; only the bottom of the sea presents terra incognita on so rich and grand a scale. Perhaps half the planet's species dwell in Amazonia, most of them still unknown to our own technological encampment. No mere ocean of green, this community is so intricately interwoven as to constitute a single vast organism, the one true Leviathan, outweighing all the whales in all the oceans of the world that have ever lived. It is the last and greatest forest on earth, and now it is disappearing before it has been discovered: At nearly an acre a second, the TransAmazon highway system and the land clearing operations it has enabled are extinguishing the forest before it can be explored. From space, Landsat pictures show the burned-over patches spreading with the highway network year by year, magenta sores in the false-color images. We, the voracious Lilliputians now, antlike, are dismantling the greatest biochemical engine on earth at a scale so vast that the carbon dioxide economy of the entire planetary atmosphere suffers. In a century of genocides, perhaps the penultimate great extinction unfolds, prologue to the threatening self-immolation of our own species.

The Amazon River Basin is ten times the size of Texas. The Brazilian state of Amazonas, alone larger than Alaska, has hardly been touched today--there is absolutely no access to vast tracts--yet, at projected development rates, the forest there will vanish soon after the turn of the century. By itself, the failed Jari River latifundium of Daniel Ludwig was as big as the state of Connecticut. Until studied for a while, the forest seems a senseless tangle. From the ground, in the green twilight, a little of the architecture of its ten-story canopy is revealed: the floor, the understory, the tree crowns, the emergent layer. Single trees with foliage spreading over an entire acre, lianas, epiphytes, strangler vines, lichens.

Europeans found the Amazon River early, in 1499; Orellana voyaged downstream in 1542. Jesuits had mapped a few of the river's 15,000 tributaries by 1691. During the Age of Exploration, areas were claimed, colonized, abandoned, forgotten again. La Condamine discovered the rubber tree and curare there; von Humboldt collected 12,000 plant specimens. The rubber boom had swept through and gone for good before World War I. Today, with desertification swiftly racing behind, settled areas are a realm of colossal timber, farming, mining projects, of gold rushes, shantytowns, and airstrips. Daily, the forest suffers its death of a thousand cuts.

\*\*\*

How things are today: This tale concerns not the thirty-foot anacondas, the twenty-foot alligators, vampire bats, army ants, but the plant world. Trouble first emerged on construction of the BR-250a highway system, one of the largest ever in the region, to service the Bug Farm, a hundred-million-dollar World Bank-financed project. Thousands of hectares had been "planted" with giant hydro-powered tuned-spectrum lamps, to attract and trap hundreds of tons of insects per night. This inexhaustible, extremely nutritious feed was supplied to poultry farms on the same sites, where special-breed "featherless biped" naked chickens were raised that could thrive in the torrid climate. (There was controversy over who was to consume these birds, though the flesh has higher protein content than conventional chicken; and even a squeamish rumor of experiments with direct but unwitting human consumption of "bug meat," a substitute product pressed and textured directly from the insects.) The Phase 2 project involved a plantation of genetically re-engineered "meat trees" that directly converted their photosynthetic output into fruit with a beefsteak-like flesh.

Bug Farm planners had become alarmed by a peculiar run of bad luck in jungle overgrowth of the road system. From their synoptic perspective, it seemed more than just the usual furious tropical verdance: creepers, tendrils, roots seemed to be consistently strangling the system at the most critical pressure points. Perhaps this was just the iron Law of Murphy, where misfortune joins entropy, that things tend to go wrong in the worst ways possible. But engineers began to joke that the jungle appeared to be pessimizing, always perfecting the worst disruptions of the highway web. As a second-order joke, some of the project's computer programmers tried taking the original joke seriously, exploring whether they could find any worse scenarios than the actual ones. Merely optimizing a network is a classical operations-analysis problem, among the most computationally costly puzzles known. The jungle overgrowth pattern turned out strangely well to approximate a worst-case scenario. Considerable supercomputer time was expended seeking worse possible disruptions; no solutions nearly as exquisitely "pessimal," rather than optimal, could be discovered. People began to speculate that things really could not be worse, that day by day, the jungle's resources were somehow concentrating in theoretically perfect, or near-perfect, de-optimizations. However, the hypothesis could not be verified, because no computer on earth was colossal enough to generate and test all the other pessimization scenarios. Blindly, inexplicably, the jungle seemed to be beating the supercomputers.

Apparently unrelated discoveries emerged. Petrologists surveying other, entirely unexplored jungle areas by high-resolution satellite imaging got some peculiar pictures. Were they a lusus naturae fluke? Did they reveal faded traces upon the face of the land of some defunct, unrecorded Pre-Columbian settlement? After all, foundation outlines of buried, long-forgotten ancient Roman villas can still be

seen from the air in English wheat fields today, two millenia later. But there was temporal, as well as spatial structure. When two pictures taken a day apart were accidentally "subtracted" from each other by computer processing, the remainder showed the pattern was changing. And the evolution was not in the expected direction, blurring toward entropy; instead, the structures were growing, and growing clearer. When search parties were landed to check for a giant termite nest complex, they found nothing. Indeed, they could not even see the forest for the trees--the patterns perceivable from space.

The pictures became curiosities among cartographers. One day, an image-analysis specialist in the United States sensed a familiarity. A week later, the isomorphism occurred to him: the pictures resembled the Bug Farm highway map. A mere Rorschach-blot coincidence? In time-lapse picture series, some of these areas, although remote from the Bug Farm, continued to evolve, like vast photographs being developed, toward ever finer resemblance to the highway network. Other areas were diverging from the highway map, but they, too, did not blur. Sometimes these seemed to become blowups of highway zones, changing slowly, like a crystal grows; sometimes they reorganized more suddenly. Soon, new isomorphisms were apparent--between these structures and subsequent overgrowth patterns on the highway system.

People began to joke again, this time that they were mind-reading, watching the jungle get an idea about how to solve the problem of its self-preservation, an insight into where best to de-optimize the human assault. The emergent structures were "mental representations," some of them sensory, some of them motor plan maps. Investigators were, then, observing modelling of the external environment, puzzle-solving by structured subgoal stages and repeated iterations, flashes of intuition, and so on.

Was anybody there? Was the rain forest functioning like an enormous nervous system? The phrase, "Forest Brain" appeared in discussion; self-styled phytoneurophysiologists began examining the anatomical and physiological feasibility of cognition here. Of course, comparisons between neuron and tree structure are embedded in the very vocabulary of neuroanatomy, although not vice versa, in botany. Microanatomy of the nerve cell cannot avoid reference to branchings, ramifications, dendrites, arborizations. Fanciful analogies could be perceived between the half-dozen layers of the human cerebral cortex, seat of higher mental functions in homo sapiens, and the similar laminar structure of rain forests. --Trees inside, trees outside. Calculations showed that, on a plant-to-neuron comparison, the Amazon Basin forest turned out in fact to be more complex than a human brain. Even the leaves outnumbered the synapses. The "anatomical" potential for massive information representation was there.

But complexity of structure is not enough; could the structure function, to process information? Trees can communicate with each other over many miles via airborne pollens and pheromones--perhaps

these served as information-conveying phytoneurotransmitters. Here would be another instance of convergent evolution, like the entirely independent development of camera-type eyes in vertebrate and octopus. Indeed, perhaps the well-known plant phototaxes and tropisms served as another type of visual receptor system. Human beings might have been wandering obliviously, over millennia, through thinking forests, like microbes inside a brain. No wonder the ubiquity of the myth of the enchanted forest; indigenes' forest animism might be vindicated. After all, isolated elements--say, in a swarm of bees, or gas molecules--can appear to behave randomly and counterproductively when, en masse, they reveal a clear pattern. If electrophysiologists could study only individual brain cell activity, not global behavior of the entire organ and organism, they would never surmise that the cells had more than purely "vegetative" functions.

The forest brain would not be the first community of intimately cooperating organisms. Any ecological system exemplifies subtle coordination among myriad separate species. Some communities can so thoroughly intermesh as truly to constitute a single organism--consider the highly specialized division of labor among the many separate populations that make up the Portuguese man-of-war jellyfish.

\*\*\*

But were we just anthropomorphizing blind Nature, sentimentally overinterpreting low-level ecological phenomena? At this point, a mistake was probably made. "Jungle lobotomists" decided on a classical ablation experiment: slice and dice some forest regions into a grid of separate plots, and see if the peculiar efficiency of the overgrowth patterns thereby decreased. But this divide and conquer mutilation boomeranged; it seems to have been the last straw. The forest response to the new insult was not so benign as mere pessimization pranks. It began reacting to land-clearing operations by oozing at night huge pools of "glue-goo," a clear, peculiarly viscous as well as sticky sap, stiffer than quicksand. When stepped on, it seemed firm; drowning men would break limbs in their motionless struggles. Dead people and machines alike were soon suspended in these huge puddles, like flies in amber. Dragline operators began resigning in panicky hordes.

And, at least to some over-active imaginations, the forest seemed to keep striking back. A company chainsawist reported to his infirmary with an extremely large wart on his thumb. This turned into the worst case of galloping warts ever recorded. One day, just the thumb involved; a week later, every millimeter of epidermis, from head to toe. Warts do not kill, of course. But no cure is known for even normal ones, nothing much better than folk nostrums like stump water. The patient was soon unrecognizable as human, the voice reduced to unintelligibly muffled croaks. We pass over in silence the rest of the course of the illness, only adding that the afflicted seem indefinitely to survive, in some sense. The racing pandemic that

followed quickly turned workers' camps into ghost towns.

(We will also not discuss the airborne killer mists that precipitated hitherto unknown super-poison oak allergic reactions, but with patients being digested by a flood of their own secretions; these little personal ecological disasters continued even after death, until only a dry, twenty-pound husk of bone and sinew remained.)

From the perspective of rattled onlookers, the forest kept on getting mad and getting even. Remote-controlled robot bulldozers counterattacked, since even prison crews would no longer enter the zones. Perhaps pollution bred a biosynthetic mutant of the copaiba tree, which naturally produces a liquid with properties like diesel fuel. After all, everyone is familiar with the mutant bees that can metabolize petrochemicals and now swarm at oil derricks throughout the world. In any case, the land-clearing machines seem to have hit groves of "dynamite trees"; the fireballs could jump a kilometer. These trees possessed a kind of photosensitive trigger which, once somehow armed, turned them into mines that could zap even airborne interlopers. And, once the danger was destroyed, the forest could turn its biochemical machinery to secreting fire-retardant glue-goo to douse the explosion-kindled conflagrations.

\*\*\*

The forest was sending "keep off the grass" messages. How were they to be interpreted? Were they just manifestations of hitherto unknown automatic natural self-defense mechanisms, no more than elaborate versions of the stingers on a nettle bush? After all, merely surviving and behaving adaptively is not enough for intelligence; an amoeba can do that, even a blindly evolving ecosystem, given enough time. It would be intriguing to find a forest meta-organism of amoeboid level, but no indication of thinking. Or, was the forest's revenge genuinely intentional action, reflecting the deliberation of a mind? We could not tell.

Here was a new twist on the classical Other Minds puzzle: What is adequate evidence--adaptive activity, appropriate abstract internal structure, whatever--that another organism possesses a mind? For, it is in principle possible that even another normally behaving humanlike thing might actually be just a behavior-generator with a blank inside--no belief system, goal hierarchy, reasoning ability, awareness. This seems more a joke than a serious puzzle for other human beings, but the burden of proof shifts for new, gray-area cases like elaborate computers, or the forest. We become enmired in a dilemma, trying to avoid implausible species-chauvinism--only homo sapiens brains could possibly think--but also trying to avoid anything-goes panpsychism--having to project mentality onto everything around us. We are wary of a basic appetite of human nature, the will to believe we are not alone, the innate drive to personify the inanimate and the mindless.

Even supposing the forest had a mind, there would be radical

incommensurabilities between it and us. Logic requires us to interpret any possible other mind as rather like ourselves, as having a coherent--to us--knowledge representation and goal structure: "Difference from me is the measure of absurdity." Yet is this how a mind objectively must be, or just the reflection of limits on our own imagination? Any understanding of each other here could not be easy. For instance, human reaction time is less than one second; the forest's fastest responses seem to require a day, ten thousand times longer. Can something be that slow, yet still be intelligent? One of the forest's strategies in confronting the rapid animal response-time regime seems to be, like the venus fly trap, to set natural "mines" with very fast triggers that can be armed and disarmed by slow, plant-speed remote signals. Indeed, art imitates nature; because human reaction times are no longer of a fast enough scale, we similarly devise computer controlled launch-on-warning systems for our own Star Wars missile defense.

Granting the forest's mindfulness, how smart is it, how much can it understand? Comparisons among incommensurables are by definition pointless; the forest can do things that we human beings cannot, but also vice versa. Still, the forest's mind might be of roughly the level of an octopus, dolphin, or chimpanzee, or of a human child, pre-technological aborigine, member of our own post-technological culture, or perhaps some more advanced form of life. And what is the qualitative, as well as quantitative, character of its putative intelligence? What is its personality? What would the forest perceive, or surmise, when it encountered the blur of human activity? Would it be terrified, enraged, puzzled? Would it think anybody was out there?

\*\*\*

Perhaps the forest interpreted the lull at this point in our onslaught as a kind of truce, rather than just the bog-down that it in fact had become. Satellite pictures showed a new set of huge evolving patterns, almost a slow-motion kaleidoscope. The forest was generating one basic geometric figure after another. A near-perfect circle fifty kilometers in diameter would emerge, then fade, to be succeeded by a square, next a triangle, and so on. No series of freaks of nature could continue so long. What was the significance, if any, of this self-administered mega-topiary? Was it just the vacant equivalent of a TV test pattern, or some kind of internal processing mechanism? It was no death rattle or white flag of surrender; experimental probe attacks against the forest met with the usual disasters. Investigators noted that the forest was not generating random visual noise, but the "good figures" of human perception and cognition--the fundamental geometric archetypes of our thought.

The natural question then was whether the forest might be attempting to communicate with us. It was unlikely to be familiar with any human language (indeed, it might be incapable of acquiring

any of them, since their learnability depends considerably on innate knowledge of their basic structure, encoded in the human genome). Perhaps the forest was now playing with the idea that whatever was attacking it was not merely a blind disease process, like an unobservable virus particle, but something else that also could understand. It may therefore have decided it was worth a try to pump out into the universe this torrent of meaningful symbols, for the benefit of whatever might be out there. Indeed, its strategy would then correspond to that of recent human attempts at extraterrestrial communication: to broadcast autodecryptograms, messages embodying patterns that ought to be universally discovered by, and important to, intelligent beings.

The geometrical shapes kaleidoscoping out of the forest might then be not so much a cry for mercy, as just a shout that someone is there. To send such a signal, of course, constitutes a leap of faith not only that whatever is out there is intelligent enough to understand, but also that it is benevolent enough not to react by redoubling its attacks.

One phenomenon lately observed and presently not understood: Night surveillance with image intensifier equipment one clear, moonless evening yielded a serendipitous discovery--the "gloema." A faint, blurred, blue-green glow could be perceived in forest areas away from the fires. Of course, phytoluminescence is not that rare, but investigators were jumpy. Follow-up time lapse studies proved difficult because, like light from a distant star, the gloema is so very faint that cameras must remain open quite long; clear, fine-resolution images of its slow evolutions are not yet feasible. We must therefore be cautious in our interpretations. Once more, the time course here is as slow as the motion of a clock's minute hand, and therefore not directly accessible to human perception. The gloema seems to have some structure in both space and time, though. In the computer-enhanced montages, a low-level glow flickers across the landscape like heat-lightning in summer: vague nimbuses here and there, and clear-edged currents like nighttime traffic on a downtown freeway. Again, the questions--is the gloema a meaningless epiphenomenon, another communication attempt, a "flash of insight"?

\*\*\*

Finally, the moral dimension. In A Rebours, Joris-Karl Huysmans, a turn-of-the-century French decadent, describes an aesthete's toy the protagonist has his jewellers construct: the carapace of a large tortoise is inlaid with gold and set with gems. Huysmans' hero then planned to contemplate this vivid, living ornament crawling across the bright colors of an oriental rug. There is something troubling about this picture. Of course, human beings must eat or die; there can be sound, utilitarian grounds for turning other living things to our ends. Perhaps some such rationale holds even for the genetically reengineered "hausfrau" ant colonies that have recently supplanted our robot vacuum-cleaners--silently, slowly, endlessly picking up and carrying off every bit of dust in the household. But then there is

the tiny model airplane in the Smithsonian that was powered by a fly glued to it. Or, some of the contemporary animal/computer-amalgam toys.

At some point, for all but moral imbeciles, the gorge rises; ends are too frivolous to justify means. We confront the prospect that the forest brain may be the solitary exemplar of its species during the entire history of the universe, a species doomed not necessarily to a mass extinction, but instead never to come any further into existence. Most species must have begun from a similarly solitary Adam, or Eve, lonely mutant from which teeming populations were to spring. Correspondingly, there must be many more untold stories of individuals or little groups who were their species' first and last members: the losers do not write history. On the first new day, how could they surmise whether the future held promise or oblivion? To carve up and incinerate the forest brain, given even current limited knowledge, therefore must make anyone uneasy. For how many thousands of years has the forest been sentient, how many eons of experience has it accumulated? To understand is to be responsible. It is this quandary that has sparked recent phytophile-phytophobe strife, including the unfortunate internecine terrorism between some persuaded of the forest's mentality and some with imperiled economic interests.

The present state of play between the human race and the forest is a modus vivendi somewhere between stalemate and truce. The forest's vast biochemical engine holds the planet's entire atmosphere hostage. Indeed, the forest seems to have arranged a few vivid tutorials to catch our policymakers' attention; it has spontaneously triggered firestorms that left smoke palls visible the world over, like the atmospheric debris from Krakatoa's explosion in the last century. Perhaps the message is that any attempt to wipe out the forest at a single stroke threatens an earthwide climate destabilization, a nuclear-winter Gotterdammerung. Bankruptcy has also helped win the forest's war; the delicate balance of fiscal viability of "mining" the forest has now tipped in its favor.

We thus hold each other hostage. Both combatants are trapped in the same ring, on this planet. Each side has to leave the other in something like peace. People still tirelessly tinker with ways to domesticate the forest, but accomplishing this seems to require understanding its phytoneurophysiology, with all the attendant dangers of empathy and consequent decency. Together we await our shared, mortal fate; together we contemplate the blank and pitiless gaze of the universe beyond.

Copyright 1987, 2000, Christopher Cherniak

University of Maryland