Reconstructing Nature: How the New Informatics are Rewrighting the Environment and Society as Bitspace

By Timothy W. Luke

1. Introduction

This article is best read as a series of questions. It asks how perhaps the still inchoate disciplines of informatics are helping to reconstruct Nature in ways rarely addressed by environmental criticism. No environment exists abstractly or independently of the organisms it envelopes, and the life forms that larger environments circumscribe, surround or encircle always transform those environments to sustain their existence. Is it as clear today, however, that humans *per se* are the organisms that Nature envelopes or are natural environments being remade to best sustain only human existence? In fact, are other perhaps posthuman agencies being born into these environments, and are they remaking the workings of both Nature and Society to optimize their survival? If they are, then commonly held notions about what the "environment" is understood to be, and how "environmentalists" must act in its defense, will require some fundamental changes.

While answers for these basic ontological questions might not be easily found today, there are odd tendencies afoot in the mobilization of new informatics — or the fusion of computer machinery, communication networks, and software applications in organized instrumental production — that reveal larger motives for reconstructing Nature in cybernetic/informatic/semiotic terms of engagement.

The devotees of digitalization, like Nicholas Negroponte, overrate the positive aspects of informatics, while they underplay how many negative social and economic tendencies, like class inequality, material

poverty and ethnic difference, will continue to play through cyberspace like they do today in most offline contexts. Negroponte is obsessed with "being digital," because it represents the ultimate expression of hypermodernized rational being. In his vision, new digital techniques for making, moving, and managing "bits" necessarily will replace many embodied forms of interaction conducted face-to-face with, by, as, and through "atoms." For Negroponte, "the change from atoms to bits is irrevocable and unstoppable,"[1] and digitalization ultimately means dematerialization as the bitspaces of networks displace the material spaces of the world's pre-informatic environments. To mark this turning point in human history, he asserts "computing is not about computers any more. It is about living."[2]

Negroponte's declaration expresses the most basic assumptions of digital materialism; and, following his lead, today's digital materialists have an interesting new program for cultural rebirth, economic growth, and social organization that uses digitalization to redefine place, power, and property in the contemporary world system. By endowing bits with command over atoms, digital materialists reimagine places as functional nodes in networks, power as the prerogative to code information, and property as quanta of value-added information quanta. Consequently, new environmental spaces that are designed in purely digitalized informational terms are being assembled within the virtual spaces of networks in order to be projected over the real spaces of Nature.

On the horizons defined by flexible accumulation, as so many spatial and cultural barriers erode away in transnational businesses' acceleration of production and consumption, it is Lyotard's vision of performativity that anchors the new world order of the 1990s and 2000s. At this juncture, "the State and/or company must abandon the idealist and humanist narratives of legitimation in order to justify the new goal: in the discourse of today's financial backers of research, the only credible goal is power. Scientists, technicians, and instruments are purchased not to find truth, but to augment power."[3] Digitalization presents a real prospect for a single operational space in which all aspects of Nature can be reduced to the same technical register. Once moved into these registers, genetic, atomic and systemic qualities of what was once unmediated Nature can be modeled, modified, and/or managed to advance the projects of transnational enterprise. Indeed, the

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[1]Nicholas Negroponte, *Being Digital* (New York: Knopf, 1995), p. 4.
[2]*Ibid.*, p. 6.
[3]Jean-Francois Lyotard, *The Postmodern Condition: A Report on Knowledge* (Minneapolis: University of Minnesota Press, 1984), p. 46.

metanational properties of the Internet radically enhance the power of even small businesses to operate transnationally in bitspace.

So far, these trends are ill-formed and incomplete, but those transnational corporate interests who are wedded to the project of performativity aim at decentering physical place, disestablishing existing territorial powers, and dismantling material property for those without the mobility, capital or information to play these games of bits. Informatics come from somewhere, and they articulate certain interests over others. The efforts by bioinformatics to mine biotic databanks, biogenetics to engineer transgenic organisms, biophysical surveillance to define biocomplexity in spatial data systems all appear to be responses to human and nonhuman organisms in Nature that can reshape the Earth's natural and artificial environments in support of their survival. And, as these moves are made, will natural life forms as such begin to be eclipsed by postmodern, posthuman, and postindustrial types of transgenic beings, which can only be born in corporate labs and which are created simply to sustain business profits in transnational commercial exchange? Can digital systems colonize terrestrial ecologies through human vectors, and thereby precipitate a "Second Creation" with transgenic life, transatomic materials or transbiotic systems through digitalization? This study touches upon these vital questions, and then considers their ramifications.

These troubling developments are already unfolding, and their enabling technologies are not likely to be packed up and then put away forever. Consequently, the new informatics are putting the very constitution of "Nature" and "Humanity" into question. If Nature becomes partially compromised by informatic interventions, or if human beings actually become fully invested in bitspace as their most decisive key environmental niche, then what must environmentalism as a political project become? On one level, today's environmentalists might attempt to prevent additional incursions by digital materialists from coming to pass. Yet, on another level, environmentalists will need to recognize that these technified forms of life are already here. Hence, new types of ethical discourse and political practice must be created to cope with the unanticipated, if not monstrous, implications of informatics.

2. The Nature of "Nature"

Few questions are either as interesting or as significant at this historical moment as the role of informatics in the economy and society, because the *modus operandi* of so many human practices are being reshaped out of bits, for bits, and by bits. These changes derive in

part, from the creation of new machinic collectives, like global computer and telecommunications networks, that knit together the interests of large transnational firms, small high-tech start-ups, professional-technical experts, and user/consumer publics, but they also reticulate, in part, the conventions of global capitalist production and consumption into everyday life, which now are colonizing time, energy, and matter as ones-and-zeros. Consequently, the operational construction of "Nature" in the economy and society frame what is accepted as the political today, and, in large part, these diagrammatics ultimately manifest themselves beneath, beyond, beside, and behind territorialized realms of matter and meaning ruled by the environments in the workings of network governance. In this informationalized environment, systemcraft becomes soulcraft, and the crafted soul then is meant to realize certain particular digital forms of being from the system of bits.

On this new telematic terrain, which has been created, enforced, and sustained both by statal and non-statal interests, new groups from all around the world are trying to reimagine human community in varied informatic terms,[4] while pushing their own peculiar interests in pursuit of illiberal traditions, neo-liberal utopias, or antiliberal resistances. With an ironic twist to Engels' famous characterization of socialism, the flow of bits over networks is moving many to think about forsaking the government of people to embrace the administration of things, which, in turn, will remediate new modes of control out of bits as a vision for digital governance over people and things is expressed in many more partial, privatized, and productive practices.

Out in the networks, people who often do not share same race, gender, class, nationality or locality all are interacting as digital beings through a variety of operational interfaces. These many different modes of virtual organization typically transpose people's material being into semiotic strings of text, synthesized speech or stylized graphics. Once on the Net, digital beings leverage cyberspace to serve various offline agendas; however, their efforts to operate together and alone in the digital domain are also creating commonalities that are pitched against their offline atomic interests. Cyberspace, as a world of bits, is essentially like Nature, or a metaterritorial space — everywhere, nowhere, here, there, anywhere, somewhere else. And, its political possibilities, especially in the ideological discourse of the digerati, are

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[4]Benedict Anderson, *Imagined Communities*, revised edition (London: Verso, 1991).

ceaselessly touted for their emancipatory benefits, which seem to be metanational in quality and quantity.

Nonetheless, the metanational characteristics of bits simultaneously become entangled with, and free from, offline atomic properties. The metanation of cyberspace can affect offline materiality with a contradictory cluster of contrary positions not unlike those implied by "the environment" and "society." Bitspace operates inside of each nation, but also outside of it; for each nation, but also not only for it; by each nation, but also not of it. As a "meta" factor, bits are coded to merge actions and structures with atoms, but the informatic frames of such postnational spaces are already always more: a deterritorialized domain of domains whose virtual/fractal/digital/viral environments of bits coexist behind, beyond or beside the atoms comprising the politico-economic nation-state system as well as the biophysical global environment.

A. A Second Creation

Clearly, Nature is an essentially contested concept, and this study constitutes another expression of its constantly contested essence. The centrality of a pure, objective, unmediated Nature in the attainment of modern scientific knowledge, however, is an idea that is dying very hard. From the vanguard of Newtonian physics in the seventeenth century to the rearguard of sociobiology in the 20th century, many schools of modern science have assumed that their methodologies provide a privileged foundation for knowledge of what is "real" in Nature as a definitive methodologically rigorous mapping of a God-given creation that is truly "out there." These unsullied observations, in turn, are believed to create a true knowledge of objective reality for Creation known now as "Nature." This knowledge often is idealized in the mathematical proofs of physics, and its applications in everyday life are widely believed to be the foundations of modernity's technological proficiency. When all is said and done, humanity is believed to know how the worlds of Nature work because of its disciplined application of these scientific methods for observation, experiment, and verification.

Yet, there also is a great deal of disquiet about these epistemological, ontological, and technological articles of faith in modernity. Their celebrants continue to praise this system of science, and its derivative technologies, for their demonstrated ability to raise industrial output, overcome deadly diseases, speed methods of travel, and enhance a longer, richer human lifespan. Few of them, however, discuss how these same modes of scientific knowledge and technical action also generate noxious by-products, cause new afflictions, create

frustrations from mobility or perhaps detract from the qualities of life. Whole movements of people — scientists and laypersons alike — have arisen increasingly in doubt, or to openly protest, these modernist formulas for legitimating scientific authority and technical power from some putatively pure rational knowledge of unmediated natural reality.[5] Of course, these movements are not universally welcomed, because the cultural place, political power, and economic property of many are deeply embedded in such modes of scientific production. Nonetheless, more resistances develop and spread with each successive new, modern generation.

Plainly, many different streams in the environmental movement have proven to be among the most ardent opponents of these fundamentalist views of science and technology. Feminists, minority peoples, and working class groups, who rarely benefit from having scientific authority or technical power, also have joined environmentalists in questioning the allegedly neutral knowledge that science provides about Nature. In its emergent days, science put forth its foundational epistemologies for dividing facts and values, theory and observation, experiments and explanations, or truth and opinion in order to challenge religious-feudal authority, whose place, power, and property in early modern society rested upon other grounds. Once those traditional enemies were overcome, science and technology increasingly shifted their legitimating discourses toward operational achievement, or technical-economic performance, and away from epistemological incorrigibility, or real knowledge of Nature's inherent rationality. Consequently, the 19th and 20th centuries saw bourgeois science and industry using the technical command over the objective forms of Nature as the great "out there" to create greater wealth and knowledge for the smaller "in here" of market economies and societies.

After the 20th century, however, everyone must deal with postmodern conditions, which essentially are, as Jameson suggests, what prevails "when the modernization process is complete and Nature is gone for good. It has become a more fully human world than the older one, but one in which 'culture' has become a veritable 'second nature.'"[6] Here technical-economic performances, like Auschwitz, Bhopal or Chernobyl, shake scientific technology's legitimacy, and a reflexive realization that anthropogenic changes in the Earth's climate,

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[5]Steve Best and Douglas Kellner, *The Postmodern Turn* (New York: Guilford, 1997).

[6]Fredric Jameson, *Postmodernism, or the Cultural Logic of Late Capitalism* (Durham: Duke University Press, 1992), p. ix.

soils, atmosphere, waters, and biomass make incorrigible epistemic certainty about the planet's autogenic activities very difficult, if not impossible, to maintain.

This new Second Creation is not as predictable as First Creation. On one level, the ecological opposition to modern science and technology is heartened by these recognitions, because their reservations finally have been registered in the theory and practice of contemporary scientists and technologists. Accordingly, these new resistance movements reason that a more self-reflexive science will be less destructive of Nature as well as more respectful of the human and nonhuman lives that dwell in the Earth's many habitats. Yet, on another level, there are no guarantees about this positive outcome, because these individuals, along with everyone else who either openly support or do not doubt modern science, find that whatever improved cultural place, political power, and economic property that millions have attained in the 20th century do depend in some part, perhaps quite large or comparatively small, on letting science continue to build upon its technological proficiencies in this anthrogenic Second Creation. Moreover, they continue to need the goods and services made possible by the global economy's on-going technical-economic performance. And, these performative outcomes are becoming more difficult to attain because of either reflexive resistance to many industries' by-products or actual physical scarcities caused by resource depletion.

At this juncture in the postmodern condition, then, new dangers emerge, and some of most fascinating, and virulently dangerous, are those which embrace these self-reflexive observations about how science and technology actually work in impure, subjective, and mediated ways to degrade, displace, or destroy Nature as such. Since Second Creation allows many to presume there is no pure, objective, unmediated Nature, then why not coevolve with a "Nature" whose impure subjective mediations always are driven by market forces? After making this admission, they move directly into self-interested efforts to reconstruct Nature informatically such that the moments of degradation, displacement, and destruction caused by a quest for power and profit will benefit their producers. Such new departures are not easy to imagine, but their proponents ultimately seek nothing less than the rewriting of place, power, and property by rewrighting the material registers in which place is fixed, power defined, and property accumulated. One of the crassest efforts to reposition all of these relations by reimaging Nature's environments are those of digital materialism which asserts what we are "becoming digital" after "being atomic."

B. Digital Materialism

Digitalization does much more than simply, as Negroponte argues, replace "the manipulation of atoms" with "the management of bits."[7] Put in machinic terms, manipulating atoms is one operating system with its own unique user interfaces, wide area networks, peripheral components, intelligent agents, and killer applications. While many forms of atom manipulation offline will not disappear, their workings are being displaced, disrupted, and disintegrated by the management of bits, and atoms, online. And, this collision of a new online machinic regime with an old offline version for coping with organic and inorganic environments through informatics will have, and indeed is already having, tremendous implications for the world by transfiguring the codes of individual subjectivity and collective solidarity.[8]

Negroponte is not entirely mistaken when he puffs up the potentialities of "being digital"[9] as the latest grand transition of modernization. In his digital materialism, the economies and societies still organized around making and moving matter, or "atoms," are allegedly slipsliding away into a new domain focused upon inventing and integrating information, or "bits." Space will be occupied by reworked atoms, but this occupation will also be filled by the flow of continuously upgraded bits. Without saying so, Negroponte essentially recasts digital technics as a nascent form of nanotechnology through which bits reach out and reshape atoms continuously at will as part and parcel of "being digital." For Nature, however, this reach stretches, most threateningly, into the genetic realm as cybercodes and cytocodes can be made equivalent in many new ways by digitalization.

Most celebrants of bits, despite their protests to the contrary, revitalize old materialist philosophies by grafting digitalization over the defunct dialectical fields of old progressive teleologies. Like orthodox communists, the advocates of digitalization presume already to know how history ends: in the classless state of full connectivity, ubiquitous computing, and 24x7 access made possible by bits. One finds many of them rhetorically twisting every new optical cable, each new microchip design, and all new operating systems into another irrefutable sign of historical progress. Digital materialists boot up the mode of information, and then find the relations of informatics and means are

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[7]Negroponte, *op. cit.*, p. 2.
[8]Timothy W. Luke, "The Politics of Digital Inequality: Access, Capability, and Distribution in Cyberspace," in Chris Toulouse and Timothy W. Luke, eds., *The Politics of Cyberspace* (New York: Routledge, 1998).
[9]Negroponte, *op. cit.*, pp. 11-20.

configuring society with more efficient cooperation — both online and offline — to attain finally full virtualization.

In most respects, informatics could be regarded as only the latest wrinkle in "modernity." Once again, one finds a fresh set of cultural transformations, resting upon destructively productive new technics with its own unformed social mores, posing as both the source and goal of yet another universalizing moral order, uniform vision of nature, and univocalized economic model. Bits, like most modern things defined by commodified commercial operations, are privileged objects, which can go from anywhere to anywhere at anytime for anybody.[10] Yet, this potential omnipresence, first, mostly glosses over how much "anywhere" in digital environments actually will remain — in world-systems terms — a set of very limited venues, or truly a privileged set of "manywheres," albeit often widely distributed geographically. Second, it also ignores how most digital packets go from somebody at one privileged site to somebody, or actually "manybodies," at another special place. And, third, it discounts how speeds in anytime are arrayed in "manytimes" as a function of willingness to pay, salience of authority, or quality of connectivity.

While Negroponte does not admit it, his digital materialist "thinking," as Deleuze and Guattari claim, always must take "place in the relationship of territory and the earth," and "the earth constantly carries out a movement of deterritorialization on the spot, by which it goes beyond any territory: it is deterritorializing and deterritorialized" in a fashion that continuously "brings together all of the elements within a single embrace while using one or another of them to deterritorialize territory."[11] Consequently, the characteristics of bits on networks always are already environmental forces, and they never should be considered apart from atoms of the earth.

Like artifactuality of the polis under the Greeks, the artifactive operations of informatics appear to be propounding an absolute plane of immanence rather than transcendence. Such sites facilitate vast movements of relative deterritorialization which coalesce physical, psychological, and social changes in "the historical relationship of the earth with the territories that take shape and pass away on it."[12] Those relations, in turn, can intertwine the forms of digital bits and physical

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[10]Mark Slouka, *War of the Worlds: Cyberspace and the High-Tech Assault on Reality* (New York: Basic, 1995).
[11]Gilles Deuleuze and Felix Guattari, *What is Philosophy?* (New York: Columbia University Press, 1994), p. 85.
[12]*Ibid.*, p. 88.

atoms with absolute metaterritorial qualities as a Second Creation. Hence,

> The earth passes into the pure plane of immanence of a Being-thought, of a Nature-thought of infinite diagrammatic movements. Thinking consists in stretching out a plane of immanence that absorbs the earth (or rather, "adsorbs" it). Deterritorialization of such a plane does not preclude reterritorialization, but posits the creation of a future new earth. Nonetheless, absolute deterritorialization can only be thought according to certain still-to-be-determined relationships with relative deterritorializations that are not only cosmic but geographical, historical, and psychosocial.[13]

The fractalizing immanence of informatics, and "the new earths" that bits might create, perhaps cannot be expressed more concretely than these observations. Unfortunately, the principles of profit appear to rest at the core of these digitally-mediated deterritorializations

Negroponte's digital being of bits now promises infinite diagrammatic movements in still-to-be-determined relationships with atoms in a metanational transgenic space. Brimming with unknown works-in-progress, lines-of-flight, and bodies-without-organs, bits reach out and command atoms. As an absolute plane of immanence, the qualities of bits are those of a constantly "movable and moving ground,"[14] and they endlessly cycle the decisive moments of founding/building/inhabiting through informatic thought and action. What is more, bits are being rapidly transversalized by capitalist exchange, and digitalization mostly works now through informatics to advance the universalization of markets. The axiomatics of commodification are very congruent with those of digitalization, so metanational environments emerge through informatics in decoded flows of bits, money, ideas, and products. These streams can erode the overcoded substance of resistant cultures, governments, and societies.[15] Because of bits, governments and markets now seem hell-bent upon "going with the flow" of digital change simply to survive, because they are "no longer paradigms of overcoding but constitute the 'models of realization' of

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[13]*Ibid.*
[14]*Ibid.*, p. 105.
[15]Don Idhe, *Technology and the Lifeworld: From Garden to Earth* (Bloomington: Indiana University Press, 1990).

this immanent axiomatic" for rapid commodification and global digitalization.[16]

3. Postmodernity as Postnaturalization?

Ultimately, then, these transformations are a function of restructuring the world economy. If Nature is gone for good, then Second Creation can be digitally remastered as a postnature at the genetic, organic, and systemic level. Specializing in primary agricultural or forestry products is no longer necessarily a path to economic growth, or even stability for those already occupying those niches. Consequently, new means of exploiting, or creating, comparative advantage in the global economy need to be discovered, and informatics are often one sure-fire method for making such discoveries. Whether it is bioengineering new transgenic animals, genetically modifying plant stocks, nanoengineering new industrial materials or reimagining agroindustrial inputs on new logistical timelines and spatial flows with GIS (geographic information systems) spatial data, informatics are now seen as an essential means for this rerationalization of transnational commerce at a national, regional, and local level. Here is how being digital burrows into the molecular registers of organic and inorganic materiality.

Informatics enables agricultural and industrial activity to fracture along three degrees of resolution — the biogenetic, biorganismic, and biosystemic — in bitspace. The inherently difficult qualities of primary product production, whether the industry is farming, forestry or fisheries, have been difficult to surmount, because Nature itself has imposed so many constraints on production. Of course, industrialized fishing, scientific forestry, and high-tech agriculture all have made some inroads toward controlling more material qualities of agricultural and industrial production, but "Nature" continues to be seen in these economic pursuits as a recalcitrant barrier against greater production. Of course, Nature also is already an enablement for production, but this characteristic is usually ignored in the quest for greater technological proficiency. Whether it is variations in land topography, random differences in soil chemistry, water quality or weather, larger ecological pressures, land use pressures, basic fishery overuse, general forest stress, or unpredictable atmospheric changes, Nature has not been a readily surveyed or easily controlled object of analysis. A reconstructed Nature with the digital materialists' Second Creation, however, offers prospects for making considerable progress in that direction. Enveloping the Earth in different layers of bitspace for informatic

[16]Deuleuze and Guattari, *op. cit.*, p. 106.

surveillance, and then material manipulation, promises to revolutionize the many practices of agricultural and industrial production.

At a biosystemic level, sophisticated GIS monitoring will allow better fishery, forest, and farming management by surveying changes in marine and terrestrial environments. GPS (global positioning satellites) technologies will permit more precision-guided, and, of course misguided, use of pesticides, herbicides, and fertilizers as well as decision-making about planting and harvesting. These spatial data inventories will, in turn, allow comprehensive global accounts to be kept of the planet's biomass, and humanity's apparent overdraft, sustainable use or undershoot of these resources.[17]

At the biorganismic level, the traditional systems of collecting germplaism, capturing new cultivars, and cultivating new commodities, which began with the expansion of European imperialism in the 16th and 17th centuries, can be tremendously rationalized as big transnational firms and universities continue their bioprospecting in Third World rainforests and other exotic biomes. The on-going scavenger hunts of bioinformatic researchers require huge pools of biological and botanical data about all of the world's known species, which will then be mined for potential scientific or economic uses. This information, in turn, can be linked up to biosystemic data or down to biogenetic mechanisms.

And, at a biogenetic level, new informatic and operational technologies now provide many options for reconstructing Nature through genetic engineering. At this juncture, the organisms created are still simple, and perhaps not at all survivable, but they are the transgenic vanguard of species that are being engineered to respond to artificial environmental conditions, like a corporation's desire to create sterile seeds, resistance to its competitors' pesticides, or propensity to grow in substandard soils. Here bits reach out into the genome and alter life's chemistry just as they reach out into the pooled data sets of bioinformatics or the spatial data surveillance of GIS to alter or administer the atoms of organisms.

This ceaseless search for performance and profit is the essence of today's postmodern condition. And, as Lyotard claims, such capitalist restructuring "continues to take place without leading to the realization of any of these dreams of emancipation."[18] With waning trust in

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[17]Timothy W. Luke, "At the End of Nature: Cyborgs, Humachines, and Environments in Postmodernity," *Environment and Planning*, A, 29, 1997, pp. 1367-1380.

[18]Lyotard, *op. cit.*, p. 39.

narratives of truth, enlightenment or progress, Lyotard argues the supporters of science and technology working behind big business fall under the sway of "another language game, in which the goal is no longer truth, but performativity — that is, the best possible input/output equation."[19] On another level, which Jameson struggles to outline, these mediations of performativity begin generating "a new social system beyond classical capitalism." [20] This system is inchoate, but it basically boils down to whatever is proliferating throughout "the world space of multinational capital."[21] More specifically, as David Harvey argues, this new multinational corporate regime began dismantling the old Fordist regime of industrial production, capital accumulation, and state intervention patched together on a national basis during the 1930s through the 1970s by welfare states. In its place, new arrangements for flexible accumulation, productive specialization, and public deregulation have surfaced since the 1970s along with the ideologies of neoliber-alism. Working within these many loosely coupled transnational alliances, Harvey observes, "flexible accumulation typically exploits a wide range of seemingly contingent geographical circumstances, and reconstitutes them as structured internal elements of its own encompassing logic....the result has been the production of fragmentation, insecurity, and ephemeral uneven development within a highly unified global space economy of capital flows."[22]

One nexus of these efforts can be found in the deployment of informatics in the biological, geographical, and material sciences. When classical science sought to assay the objective qualities of Nature, it largely dealt with it by defining a new layer of operational secondary characteristics beyond those evident to lay people in the common sense realms of what can be tasted, touched, smelled, seen or heard. Beyond those primary properties, science claimed it could observe, act upon, and then explain more elementary features of Nature through the secondary characteristics that its experimental testing disclosed. The progress of science, in turn, essentially has been marked by pushing down into various layers of matter from palpable stuff to subatomic layers of granularity. Secondary qualities are those found in, and confirmed by, such experimentation. Informatics seek to uncover new tertiary qualities in Nature, which now are grasped as, manipulated through, and experimented upon, first, as bits rather than atoms. Of

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[19]*Ibid.*, p. 46.
[20]Jameson, *op. cit.,* p. 59.
[21]*Ibid.*, p. 54.
[22]David Harvey, *The Condition of Postmodernity* (Oxford: Blackwell, 1989), pp. 294-296.

course, the quiddity of matter will be altered by such informatic sciences, but critical mechanisms of action, patterns of behavior, or structures of change are being disclosed first through informatics instead of physics.

Bioinformatic connections, geophysical biocomplexity or biotechnological phenomena often can, in fact, only be detected by mining data rather than shifting through matter as such. This operational shift is foundationally important, because it redefines what Nature is understood to be as well as where its determinate position, energy, and matter are located in terms of a digital Second Creation. While this might not appear significant, these questions are central for defining place, power, and property. Since Nature is no longer regarded as unmediated or objective, informatics often exalts in unabashedly exploiting the commercial and power-seeking potentials lying untested in today's anthrogenic Nature.

Bioinformatics is still a nebulously defined field of study, and it sweeps across many realms of research. Often considered to be "at the interface of biological sciences and information technology," it also encompasses

> the design and construction of databanks for organizing and storing vast quantities of DNA sequence and genetic data, and the sophisticated computational techniques to mine these databanks for novel discoveries. It includes technology development as well as data analysis techniques to explore how a myriad of genes work together as a complex system. Bioinformatics seeks to link genetics, gene expression (as protein products), protein function, the study of the entire metabolic pathway, and how these are involved in growth, development, and function of cells, tissues, and whole plants and animals.[23]

These goals are attainable only by articulating tertiary systemic attributes in biogenetic activity that can only be captured in large pooled data sets. Thus, real basic science here is conducted first by dealing with bits instead of atoms.

Bioinformatics provides scientific tools that operate on three levels of application, and all three can occur as data manipulations. The first is

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[23]Jeff Douglas and Susan Trulove, "Bioinformatics: An Evolution that has Joined the Muscle of Math and Computing at the Heart of the Life Sciences," *Virginia Tech Research,* Winter, 2001, pp. 13-18.

data management, and it addresses inconsistencies in DNA-sequence gel images. Not all experiments to decode or sequence biotic material are reproducible, and operating better algorithms to evaluate these images is critical. Second, bioinformatics does pooled data-driven sequence analysis to find new patterns of functionality in conflicting and fragmentary sets of data. Computational work of this sort is often needed to reassemble sequences with their whole functionality. And, third, bioinformatic analysis, once data are rendered more intelligible and arrayed into meaningful patterns, must infer functionality at the cellular level in disease or normal activity.[24] Clearly, biochemical and biophysical interactions are occurring because of material processes. Bioinformatics, however, seeks to winnow the processes behind physiological interactions, morphological deformations or metabolic disruptions by surveying the ones-and-zeros of genetic data.

These data are quite complex, because the essential building blocks of all enzymatic and functional structures in living organisms are proteins which link together amino acids into polypeptides. Four different base chemicals — A(adenine), G(guanine), C(cytosine), and T(thymine) — are arrayed three at a time in sixty-four (4^3) combinations constitute the encoded genetic messages in every cell's DNA. The expression of these encoded AGCT messages can range from a few to thousands of letters long. Obviously, these complex mathematical iterations provide a basis for bioinformatics, which asks a number of analytical questions: how are proteins expressed, how do enzymatic and functional structures develop, can alternative enzymes perform better, can structural flaws be avoided, can synthetic peptides compensate for natural ones, how does glycosylation alter proteins, why do these codes breakdown, what causes the peptides to continue?[25]

On one level, the code's operators all exist in Nature; but, on another level, the code cannot be mined effectively without approaching Nature as a hyperreal bitstream spilling out of huge hitherto unmapped data mines. In turn, Nature's more subjunctive postmodern dispositions can be pulled together by artful data miners. That is, as Dessy asserts,

> The push is on to create large libraries of data that contain base sequences, amino-acid sequences, and their glycosylation accent marks for plants, microorganisms, and animals. Then scientists search the data for concordance, the way that language experts

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[24]*Ibid.*, pp. 16-17.

[25]Raymond Dessy, "What is Bioinformatics?" *Virginia Tech Research*, Winter, 2001, p. 14.

> identify authors of texts, such as the Gospels or poems from the Shakespearean time. They data-mine to find similar structures in the bio-texts of plants and animals, so that they can reveal novel aspects of basic biology, inexpensively create new and better drugs, begin to understand how natural chemicals function, and to predict what man-made structures might be better, or find how genetically linked diseases start, and how they may be cured.[26]

While the bioinformatics narrative casts this science in these interpretive terms of naïve discovery, there are authorial intentions behind these moves. Breaking genetic codes also will enable their remaking in ways which can rewrite their recorders' place, power, and property relations in society.

Most significantly, these manipulations of bits can facilitate the reengineering of atoms through the mediations of genetic reengineering. Animal scientists, for example, have extracted gene sequences from humans, which can be implanted in other mammals, and this operation enables them to produce human proteins with medicinal applications from such creatures as transgenic pigs and cows. Factors A and B in blood clotting mechanisms already are produced in the milk of transgenic cows, and fibrinogen products for surgical glue and bone repair also are being harvested in a comparable fashion. By finding the best chromosomic site for foreign protein expression, bioinformatics greatly rationalize the production of such "bio-reactors" from the animal and plant kingdoms to generate proteins with new commercial possibilities. Genes are specific sets of amino acid clusters, and a single chromosome can contain 150 million bases in its codes to create a potato, a pig or a person. Yet, bioinformatics no longer necessarily respects the natural species divides that traditional genetic manipulations had to work within. Bioinformatics makes possible more advanced biogenetic engineering, and both of them are pitched at producing highly diverse transgenic lifeforms in pursuit of commerce.

From these conceptual readings, the informatic reconstruction of Nature could be interpreted as a historical-geographic condition, a political-economic means of production or a cultural-ethical regime of representation. All three of these possibilities, however, reveal a unique spatial and temporal project that seeks to rewrite the plasmic and atomic codes of Nature through digitalization. While they are far from perfect, the qualities of bits meet the postnational, antispatial and acultural

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[26] *Ibid.*, p. 14.

requirements of transnational performativity. And, the radical materialist (re)encoding of societies, individuals, and ecologies aims at ending a politics of economic limits in the end-to-end solutions of networked digitalization. Informatics is, in too many ways, no longer human in shape or substance; its methods remediate Nature's living subjects and informatic objects in new posthuman regimes of subjection to exchange at the atomic, genetic or kinetic level.[27] As bits, it would appear that global business and high technology have found new operational patterns to interlock individuals and groups into the proliferating world spaces of transnational capital.

4. Informatics as the Posthuman/Postnatural

The pace and scope of radical change throughout informatic economies and societies, as they compound their effects in postmodernizing time-space compression, often are attributed to the technics of digitalization. At the same time, is one outcome of seeing the postmodern emerging everywhere a shift in our basic philosophical anthropology? The remediation of cultural meaning and political power by human/computer interactions, perhaps must be reimagined in more sophisticated metaphysical terms as a postnatural "posthumanism." In many ways, however, it is not clear how fully posthumanism differs from transnational capital embedding its requirements for profitable performativity at the transgenic, biosystemic or digital level of being.

Perhaps more than any other contemporary technology, informatics reaffirm Ihab Hassan's anticipation of "posthumanism." When digital traces allow artistic agency to express itself through photons in online operas, or bit-based bioengineering permit jellyfish to intermix with moths that produce glow-in-the-dark pest larvae, human beings and Nature are different. Hassan asserts, "we need to understand that the human form — including human desire and all its external representations may be changing radically...five hundred years of humanism may be coming to an end as humanism transforms itself into something we must helplessly call posthumanism."[28] Such "posthumans,"[29] as Katherine N. Hayles tells us, already are happily at work and play on the Net, and their desires seem to find adequate

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[27]Luke, 1997, *op. cit.*

[28]Ihab Hassan, "Prometheus as Performer: Towards a Posthumanist Culture," in Michael Benamou and Charles Caramella, eds., *Performance in Modern Change* (Madison: Coda Press, 1977), p. 212.

[29]Katherine N. Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

expression in the bitspace provided by e-lancing temp assignments, online stock exchanges, and gender-bending alt.sex webchat rooms. Of course, how we became posthuman for Hayles is mostly reduced to the work of machine intelligence, social chaos, and decentered individuality.

Hayles argues that posthumanism forces us to regard machines as being more than merely machines, and then accept how digitalization has created a new metaphysics of the posthuman in a digital postnatural domain for all of us. Hayles feels that those still clinging inflexibly to the ontopolitical writs of liberal humanist values will experience panic attacks before the buzz of bits, because they immediately recognize how much "the system" itself, rather than some identifiable human master controller in a network sysops center somewhere, really holds the solution in these digital worlds. She invites us to accept the posthuman, and give up those fictive human selves inherited from liberal state of nature stories, who enter into covenants corporeal and intellectual to create civic order among themselves in a state of Nature. In doing so, the non/a/postpolitical space of bits is remade into the political domains of a denatured postnature.[30] As desiring posthuman bodies, the prospect of living with, or worse yet, living inside intelligent machines, or transgenic organisms, illuminated by the light of flickering signifiers or swimming in commercially-viable polypeptides, is a far more awesome promise. Some posthuman metaphysicians, like Hans Moravec, imagine these selves will choose either to upload their consciousness into biocybernetic computing devices or to dump their identities out on the Net. [31] Others, like Joseph Weizenbaum, demand that human beings somehow remain "in control," because only these selves have the agency and consciousness needed to command, control, and communicate the computing machineries coordinating digitalized organic and inorganic life. [32] And still others, like Ray Kurzweil regard today's computers as forebearers of "spiritual machines," which are allegedly part of an "inexorable emergence" of a new form of intelligence on earth. [33]

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[30]Timothy W. Luke, "Liberal Society and Cyborg Subjectivity: The Politics of Environments, Bodies, and Nature," *Alternatives: A Journal of World Policy*, 21, 1, 1996.

[31]Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence* (Cambridge, MA: Harvard University Press, 1988).

[32]Joseph Weizenbaum, *Computer Power and Human Reason: From Judgement to Calculation* (New York: W.H. Freeman, 1976).

[33]Ray Kurzweil, *The Age of Spiritual Machines: When Computers Exceed Human Intelligence* (New York: Viking, 1999), p. 288.

To digital beings, Hayles suggests that humans have never been "in control" of emergent chaotic processes constituting the conflicted amalgams of Nature and Society. Whether they are offline or online, no self stands alone, no organism can be differentiated entirely from its environment, and no agency operates outside of structure for its articulation. Posthumanism does not need to realize fantasies about "jacking" into cyberspace *pace* Gibson's *Neuromancer* novels or bioengineering the cybernetically aware "wetware" of Rudy Rucker's robot stories in truly posthuman efforts to leave the "meatworld" behind. Instead the postnatural simply concedes that neural networks, intelligent bots, and expert programs may exercise types of judgment equal, or superior, to human decision-making and action-taking.

Like military pilots entrusting their security to fly-by-wire avionics in the aerial envelope of an F-117's or B-2's stealthy flight, this cybernetic coexistence of human and machine consciousness presumes new assemblies of animal-and-apparatus activity. In many ways, they only are crudely foreshadowed by today's transgenic organisms or biotic prostheses, but they promise, enhance and expand sentient organic awareness with deep digital modifications. As Hayles asserts, "in this account, emergence replaces teleology; reflexive epistemology replaces objectivism; distributed cognition replaces autonomous will; embodiment replaces a body screen as a support system for the mind; and a dynamic partnership between humans and intelligent machines replaces the liberal humanist subject's manifest destiny to dominate and control nature."[34] Amid these chaotic complexities, most government regulations simply become one more convenient corral of containment for the new performativity based upon integrated informatic systems.

Such developments, however, will never be, as Bill Gates asserts, "friction-free." Instead, as Lyotard suggests, "economic powers have reached the point of imperiling the stability of the State through new forms of the circulation of capital that go by the generic name of *multinational corporations*," and these new modes of revalorizing exchange "imply that investment decisions have, at least in part, passed beyond the control of the nation-states."[35] Even though it is not what Hayles envisioned when she cast posthumanism as that condition in which no organism can be entirely differentiated from its environment, no self is separate from society, and no agency lacks structure, corporate

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[34]Hayles, *op. cit.*, p. 288.
[35]Lyotard, *op. cit.*, p. 5.

powers are growing so pervasive online and offline that bits are becoming an almost determinate mode of being for many.

Emergent knowledges framed as bits begin "circulating along the same lines as money, instead of for its 'educational' value or political (administrative, diplomatic, military) importance; the pertinent distinction would no longer be between knowledge and ignorance, but rather, as is the case with money, between 'payment knowledge' and 'investment knowledge' — in other words, between units of knowledge exchange in a daily maintenance framework (the reconstitution of the work force, 'survival') versus funds of knowledge dedicated to optimizing the performance of a project."[36] In telematic networks, in bioengineered organisms, in GIS surveillance, bits can meld payment and investment knowledge into a single performative flow that pays out by drawing new investments, and draws new investments as its payoff.

By fabricating digital domains, and then continuously struggling to master their informatic being, posthumans fulfill Lyotard's prophecies about "the postmodern condition" in a reconstructed Nature. That is, "knowledge in the form of an informational commodity indispensable to productive power is already, and will continue to be, a major — perhaps *the* major — stake in the worldwide competition for power," in fact, the struggle over digital assets intranationally and transnationally illustrates how fully the residents of nation-states must fight informatic oligarchs for "control of information, just as they battled in the past for control over territory, and afterwards for control of access to and exploitation of raw materials and cheap labor."[37] Informatic approaches to Nature always "is and will be produced in order to be sold, it is and will be consumed in order to be valorized in a new production: in both cases, the goal is exchange."[38]

In these bitspaces, everything in Nature as well as society, the marketplace, and culture at the genetic, organismic, and systemic levels are,

> made conditional on performativity. The redefinition of the norms of life consists in enhancing the system's competence for power. That this is the case is particularly evident in the introduction of telematic technology: the technocrats see in telematics a promise of liberalization and enrichment in the interactions between interlocutors; but what makes

[36] *Ibid.*, p. 6.
[37] *Ibid.*, p.5.
[38] *Ibid.*, p.4.

> this process attractive for them is that it will result in new tensions in the system, and these will lead to an improvement in its performativity.[39]

The digital convergence of such postnatural strategies behind "becoming posthuman" is actually why "the posthuman becomes us." After chiding states for decades about their regulation, taxation, and administration, corporate authorities now have stumbled across bits in their neo-liberal campaigns against government only to find digitalization perfectly adapted to the mythos of market culture.

How the posthuman "becomes us" can be found — as Negroponte asserts — through the efficient ensembles of markets. Of course, who is "us," and how many of "us" there really are, also become very intriguing questions for posthumans. At the dawn of modernity, *The Prince* propounded a new foundational design for sovereign selves to act as one, in one, by one within an international system.[40] Negroponte is not it, but perhaps the posthuman world now awaits an author, or perhaps only a applet script or genetic resequencer, capable of writing *The Platform*, *The Protocol* or *The Program(mer)* needed to redesign "us" to fit the bitspaces of this transnational digitized condition.

5. Conclusion

Despite what Negroponte claims about our posthuman hopes as digital beings to leave the messiness of atomic life behind us, can the old commonly found contours of inequality, abjection, and powerlessness experienced in the world of atoms still be discovered in the realm of bits? Whether it is posthuman or human inequality, inequality clearly seems to persist. "Becoming posthuman" against the new horizon of informatics unfortunately echoes other comforting liberal myths for those who already have too much, but it can be a sorely misplaced hope for those who already have so little, simply because they historically have not dominated others, controlled nature, and possessed intelligent machines.[41] "How we became posthuman" is quite obvious. The prevailing norms of global capitalist exchange indicate this broad fashioning of the posthuman truly does "become us" who can afford to live where the modernization process is complete and

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[39]*Ibid*., p. 64.

[40]R.B.J. Walker, *Inside/Outside: International Relations as Political Theory* (Cambridge: Cambridge University Press, 1993).

[41]See Don Ihde, *op. cit*.; David E. Nye, *Electrifying America: Social Meanings of a New Technology* (Cambridge, MA: MIT Press, 1990); Lewis Mumford, *The Pentagon of Power* (New York: Harcourt Brace, 1979).

Nature is gone for good.[42] In turn, its celebrants puff up what postnature holds ready for the posthuman: "the spiritual machine,"[43] "the hive mind"[44] or "robot intelligence"[45] that contemporary informatics throw forth.

The genetic recoding of digital beings from informationalized lifeworlds brings "the system" almost all the way home. Posthuman being becomes us, because, as Baudrillard observes,

> The *consumption* of individuals mediates the *productivity* of corporate capital; it becomes a productive force required by the functioning of the system itself, by its process of reproduction and survival. In other words, there are these kinds of needs because the system of corporate production needs them. And the needs invested by the individual consumer today are just as essential to the order of production as the capital invested by the capitalist entrepreneur and the labor power invested in the wage laborer. It is *all* capital.[46]

A crude functionalism actually is not in play here. One instead sees the informatic grids of command/control/communication/intelligence bits out on the Net remediating the elective affinities of capital. By drawing technologies of the self (consumer decisions to exercise purchasing power) together with technologies of production (producer choices to organize adding value) all goods and services are recast to operate, either entirely or in part, as bits.

Bioinformatic data mining is the perfect summation of posthumanized operationality in transnational corporate capitalist exchange. Even junk DNA can have important commercial applications. So informational reanalysis provides the first principle for revalorizing commerce 24x7. In the digital domain,

> Everything has to be sacrificed to the principle that things must have an operational genesis. So far as

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[42]Lewis Mumford, T*echnics and Civilization* (New York: Harcourt Brace Jovanovich, 1963).
[43]See Kurzweil, *op. cit.*
[44]See Kevin Kelly, *Out of Control: The Rise of Neo-Biological Civilization* (Reading, MA: Addison-Wesley, 1994).
[45]See Moravec, *op. cit.*
[46]Jean Baudrillard, *For a Critique of the Political Economy of the Sign* (St. Louis: Telos Press, 1981), p. 82.

> production is concerned, it is no longer the Earth that produces, or labor that creates wealth...rather, it is Capital that *makes* the Earth and Labor *produce*. Work is no longer an action, it is an operation. Consumption no longer means the simple enjoyment of goods, it means having (someone) enjoy something — an operation modelled on, and keyed to, the differential range of sign-objects. Communication is a matter not of speaking but of making people speak. Information involves not knowledge but making people know.[47]

Informationalization seeks to turn everyone, every creature, every thing, and every system into known operational quantities as bits, and knowledge on/from/with such bits becomes the posthumanized "us" in a digitally reconstructed Nature.

These informatic maneuvers essentially write new ontologues for a Second Creation tied to an anthrogenically reconstructed Nature rooted in digital materialism. Whether it is GIS-enabled biocomplexity modelling or a bioinformatically-mapped transgenic organism modifying, such reconstructions of Nature are rendering, as Donna Haraway claims, "thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines."[48] Recasting the world as bits in order to surpass, but also acquire control over, the world as atoms, is a project devoted to "systematizing something that is resolutely unsystematic, and historicizing something that is resolutely ahistorical,"[49] namely, the imperatives of commodification through reconstructing Nature. Indeed, the informatic transformation of Nature fulfills Haraway's anticipations of how contemporary ontologies must be propounded through "chimeras, theorized and fabricated hybrids of machine and organism."[50]

Some have, like Robyn Eckersley, misconstrued the shadows cast by these intermingled organic and inorganic realms as the basic writ for a fundamentalist ecocentrism. "The world," she maintains, "is an intrinsically dynamic, interconnected web of relations, in which there

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[47]Jean Baudrillard, *The Transparency of Evil: Essays on Extreme Phenomena* (London: Verso, 1993), pp. 45-46.
[48]Donna Haraway, *Simians, Cyborgs, and Women* (New York: Routledge, 1991), P. 152.
[49]Jameson, *op. cit.*, p. 418.
[50]Harraway, *op. cit.*, p. 150.

are no absolutely discrete entities and absolute dividing lines between the living and the nonliving, the animate and inanimate, or the human and the nonhuman."[51] Of course, these statements are true. Still, her biotic favoritism prevents her from recognizing the living may well be StarLink corn, the inanimate could be a conversant telematic car, and the nonhuman a human clotting factor producing transgenic milch cow. Once in the grips of informatics, all dynamic interconnected webs of relations intertwine the natural and artificial, mind and body, organisms and machines — the world of reconstructed Nature cannot be anything other than "ambiguously natural and crafted."[52]

On one level, bits are simply rhetorical representations of various ideological projects, like Nicholas Negroponte's posthuman visions of "being digital," that dress out cybernetic goods and services in the semantic costumes of more traditional activities. On a second level, bits are markers for a new global infrastructure of material systems — chips and cables, routines and routers, modems and machines all stacked up upon itself as a new built environment. Such physical assets cannot be discounted entirely from cyberspace, because without these components little would operate. And, on a third level, bits are institutionalized ideolects whose code-carrying capabilities coevolve hand-in-hand with a posthuman and postnatural vision of life grounded upon ones-and-zeros at the biogenetic, biorganismic, and biosystemic level. Obtaining control over specific segments of capital, labor, knowledge, and communication now is moving their handlers to embed ownership and control at both the genetic and atomic level through such new forms of informatic power. Thus, big sociotechnical systems can be rewrought as biogenetic entities in an anthrogenic Second Creation with their own virtual and material assets to serve, protect, and defend, giving this digitally reconstructed Nature ominous new meanings.

The shift into bitspace poses a major challenge for both critical theory and environmentalism. Billions of people do not, can not, and probably will not ever benefit from the informatic reengineering of Nature. Second Creation is in many ways a for-profit proposition for those who have the means to purchase informationalized goods and services. Of course, the utopian texts of big pharma firms, transnational media companies, and major computer corporations will promise a world where everything is available to everyone all the time anywhere, but these claims only mystify how fully most bitspaces still are

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[51]Robyn Eckersley, *Environmentalism and Political Theory* (Albany: SUNY Press, 1992), p. 49.
[52]Harraway, *op. cit.*, p. 149.

something available only sometimes from special somewheres to those who are already somebody. The merits of finding foundational purposes, values or meaning in Nature as such also are being undercut entirely by informatics. To the extent that bitspace allows capital to interpose its ends and means over those of Nature, environmentalists will be less able to protect environments on their own intrinsic terms. Indeed, those terms and their intrinsic qualities could henceforth be only contingent constructs drawn from genetic engineering, nanotechnological manipulations or biocomplexity models. Certainly, this reconfigured informatic world would offer its own resources for political action, but those actions would no longer, in Second Creation could no longer, easily claim to put "earth first," make Nature "primary," or defend "pristine environments."

Here one finds that bits will reach out, touch someone, organize something, and then rewright both human acts and non-human artifacts as clusters of operational performativity. Clearly, fresh forms of life with their own paths to progress will emerge in bitspace, but it is less obvious if this "progress" is truly desirable, who will define it, and whom shall be denied its benefits. With regard to Nature's reconstruction, then, one can no longer talk about digitalization "and" politics. On the contrary, digitalization *is* politics at the genetic, organismic, and systemic level.

As a multiplicity whose dimensions, directions, and determinations remediate the surplus value seeking of capital, bits now can entwine the political and economic at a more intense atomic level of organic and inorganic interoperation. Hence, the political, or those arrangements for who dominates whom, from the inside as well as from the outside of which systems, now must be examined, first and foremost, for their digitalized reticulations through anthrogenic Nature and its performative reconstructions. And, at the very least, these developments challenge what is understood as "the environment," who "environmentalists" are, and whom among them should work to defend it through "environmentalism."