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The Automaton of the Anthropocene: On Carbosilicon Machines and Cyberfossil Capital

Natural equilibriums will be increasingly reliant upon human intervention, and a time will come when vast programmes will need to be set up in order to regulate the relationship between oxygen, ozone and carbon dioxide in the Earth's atmosphere. We might just as well rename environmental ecology *machinic ecology*, because Cosmic and human praxis has only ever been a question of machines, even, dare I say it, of war machines. From time immemorial "nature" has been at war with life! The pursuit of mastery over the mechanosphere will have to begin immediately if the acceleration of techno-scientific progress and the pressure of huge population increases are to be dealt with.
—Félix Guattari, *The Three Ecologies*

As social life becomes mature, the social unemployment of machines will become as marked as the present technological unemployment of men.
—Louis Mumford, *Technics and Civilization*

The Bicephalous Machine

The history of industrial civilization can be depicted as a bicephalous chimera whose heads grew out of the same machine, innervated each other, and, after further metamorphoses, still

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attempt to hegemonize each other. The two heads are Energy and Information, and they bifurcated out of the industrial machine of the nineteenth century, although at different tempos. They initiated and extended two technological lineages: the civilizations of Carbon and Silicon, respectively, the one of energy as a medium of motion and the one of energy as a medium of control and communication. The two regimes carried different *entropic costs* and also quite different *colonial costs*, having been developed at different historical stages and latitudes of the planet. Although, for instance, Charles Babbage's (1832: 153) Analytical Engine was potentially ready to replace "the mental division of labor" in the industrial factory, only the microchips and labor composition of the twentieth century would be able to trigger the corresponding information revolution. And although Karl Marx registered the "metabolic rift" (Foster 1999) caused by the pollution of "carboniferous capitalism" (Mumford [1934] 2010: 156) on the English landscape, the input and output of the industrial apparatus set in motion a gigantic web of economic relations and supply chains that enslaved populations beyond the borders of the British Empire.

The thermodynamic engine is correctly identified as the central axis of the Industrial Revolution, but the flows of primitive accumulation that prepared its terrain are today finally recognized: the significant contribution of agricultural enclosures, resources expropriation, colonial invasions, unpaid domestic labor, and slavery. Since Marx's formulation, the industrial machine is perceived specifically as the diagram of surplus value, in which machinery is *dead labor* that dialectically absorbs workers' *living labor*. After cybernetics (Wiener 1948) and Gilles Deleuze and Félix Guattari's philosophy of the assemblage (DeLanda 2016), the machine is described in a less dialectical way as a conurbation of flows of money, energy, matter, and information. The unruly technosphere responsible for the Anthropocene should be analyzed with both approaches in mind: the one that sees the machine as a diagram of surplus, accumulation, and crisis and the one that sees it as a network of flows that responds to a larger social ecology.

Rather than engaging in metaphysical debates on the opposition between Nature and Society, this essay looks for an *empirical assemblage* where the connection between the two, through the paradigms of energy and information, can be studied. The essay illustrates the industrial machine as the forgotten bifurcation of energy and information and follows such a bifurcation along three stages: the industrial factory, the cybernetic society, and planetary computation. Labor is made of energy and information, and so also is capital. By defining labor as the composition of energy and information, labor can be woven back into the fabric of the Anthropocene paradigm, which itself emerged as a complex architecture of energy and information. Within this picture, labor remains the collective agency that is socially and politically separated by technology and that appears, then, to be "encrypted" (or, more interestingly, *outcrypted*) in all subsequent regimes of production.[1] In this respect, the Anthropocene paradigm seems complicit with a mode of governance that attempts to dissolve labor conflicts into the fabric of information and energy, thus mystifying labor into technological forms so as to render it invisible (as argued in the case of automation by Giedion 1948).

The intimate relation between labor and the energy economy has been investigated since the energy crisis of the 1970s that George Caffentzis ([1980] 1992) rightly renames a "work/energy crisis." Caffentzis notices that information is required by capital to allocate resources and workers in the most efficient way against entropy: *information is the economic intelligence of energy*. But more importantly, both information revolution and energy crisis are responses to the social movements of the 1960s and their refusal of labor. Similarly, this essay tries to weave together the *energy theory of labor* (labor as manual activity) with the *information theory of labor*, that is, labor as a source of information that gives form to energy and matter.

A genealogical study of information that goes back to the industrial age is worthwhile. The global technosphere responsible for the Anthropocene still resembles, in its form and function, the automaton of the industrial age, which was described also by Marx ([1867] 1981: 544) as a central axis of production running nonstop and orchestrating the overall division of mental and manual labor in the factory. Sadly, the *automaton* of the technosphere and its comfort narratives (such as the myth of technological singularity) appears to mirror and capture today the *autonomy* of social movements theorized and practiced in the previous decades.

Confronting the Anthropocene paradigm with Guattari's *machinic ecology* (that includes the inorganic, organic, technological, economic, and psychic spheres within the same *Umwelt*), this essay attempts to recompose the *epistemic rift* between energy and information that was provoked by industrial capitalism and then amplified by cybernetics and the digital revolution. The recombination of *labor's intelligence* (Schaffer 1994), that is, a novel assemblage of energy and information at a higher scale of labor, will be proposed as a necessary passage toward the *machinic ecology* that Guattari envisioned also as a political ecology of the mind.

As much as political economy has discovered the substrate of energy and labor in the diagram of information capitalism too late (for focusing on frictionless paradigms such as knowledge economy and network society for too long), ecology has overlooked the role of information in the *Bildung* of its own cognitive map. If the critique of industrialism helped to recognize the metabolism of energy and matter also in the regime of information machines (see the idea of media geology in Parikka 2015), likewise a new critique of cybernetics should help to remind us of the role of information in the growth crisis of the old industrial apparatus. The two regimes of industrialism and informationalism will be hopefully described, one day, according to a paradigm that is capable of comprehending their continuum, intersections, and bifurcations, that is, their coevolution.

If labor is reframed according to the composition of the flows of energy and information, a new theory of machine is also necessary. At the end of the essay, the sketch of the *carbosilicon machine* (the infoenergetic assemblage that emerged with the coupling of the Turing machine and the thermodynamic engine) will hopefully cast a different light on the politics of the Anthropocene and the division of labor engendered by the age of planetary computation and logistics. In the last part of the essay, the two paradigms of "fossil capital" (Malm 2016) and "control revolution" (Beniger 1986) will be united into the exploratory idea of *cyberfossil capital*, the ultimate assemblage of the perennial flows of energy and information.

Coal, or the Fuel of Abstract Labor

It was Gilbert Simondon (2009: 20) who noticed that the industrial machine was already an *infomechanical relay*, as it was separating, for the first time, the traditional form of labor in a source of *energy* (propelled by natural resources such as water or coal) and a source of *information* (the conscious movements and instructions of workers supervising the machine). In this view, the traditional *tool* is a design in which energy and information are still united: with the hammer, for example, the preindustrial artisan was providing both energy and form in the same gesture. It was thanks to their separation (bifurcation) that the flows of energy and information could be governed and exponentially multiplied by capital.

The Industrial Revolution was the reorganization of the labor power of the manufacturing age around the gigantic master axis of the factory—of which workers and flows of natural resources became mere prostheses. The Scottish business theorist Andrew Ure (whom Marx humorously called "the Pindar of the automatic factory" for his extravagant prose) described the industrial apparatus as "a vast automaton, composed of various mechanical and intellectual organs, acting in uninterrupted concert for the production of a common object, all of them being subordinate to a self-regulated moving force" (Ure 1835; quoted in Marx [1867] 1981: 544). In a similar way, Babbage (1832) recognized a division of manual and mental labor within the management of the factory and imagined two different forms for their mechanization: whereas thermodynamic machines were replacing manual labor, his Analytical Engines, prototypes of modern calculators (yet never finalized during his life), were supposed to automate, for instance, the intellectual labor of the factory's accountants. The automation of mental labor (information) takes hold through a more profound relation with the metabolism of energy.

Andreas Malm (2013) has illustrated how the motion of the rising industrial automaton had to be propelled by a stable and versatile form of energy, which happened to be found in coal. The physical properties of coal (lightness, homogeneity, measurability, calorific potential) crucially contributed to the acceleration of industrial capitalism. Steam engines replaced water mills not because coal was cheaper and more abundant than water, but because it provided a more stable flow of power than rainfalls and allowed factories to move close to urban areas, where most of the workers were living at the time. Malm registers in this way the energetic reason for the slow emergence of the industrial mode of production out of the manufacturing age: indeed, it took roughly forty years for the steam engine to be adopted in the place of the water mill. Coal came to be used across the full spectrum of production since it was the most adequate source of *abstract energy*—where *abstract* means easily computable in terms of cost, transport, stock, and performance. Coal could be transformed into a systemic component of capital only via a technological innovation, that is, the thermodynamic engine.

> For coal to be universalised as a fuel for all sorts of commodity production, it had to be turned into a source of mechanical energy—and, more precisely, of rotary motion. Only by coupling the combustion of coal to the rotation of a wheel could fossil fuels be made to fire the general process of growth: increased production—and transportation—of all kinds of commodities. This is why James Watt's steam engine is widely identified as the fatal breakthrough into a warmer world. (Malm 2013: 18)

What is recognized in the gears of such an industrial artifact is also the coupling of *abstract energy* and *abstract labor*.[2] Malm spotlights, in particular, the subtle relation between the energetic versatility of coal and the consolidation of the new spatiotemporal abstractions of capital, namely, urban factories and their clock-based labor discipline. Coal provided the energetic continuum that was necessary for the disciplinary abstractions of industrial time and industrial space to emerge.[3]

Extending Malm's genealogy, it may be added that the abstract properties of information emerged thanks to the nature of fossil energy, to its homogeneous carbon chains, that made coal easier to quantify and compute than traditional sources, such as water or animal power. If coal could be turned into *abstract energy* and labor into *abstract labor*, this happened specifically thanks to two new technologies of control at the center of the industrial apparatus: "closed-loop feedback devices like James Watt's steam governor (1788) and preprogrammed open-loop controllers like those of the Jacquard loom (1801)" (as noted by Beniger 1986: 17). The steam governor was a device to maintain the constant output of an engine by regulating its fuel input in real time (retrospectively, it is considered the first cybernetic device). The punched card was a data device to store instructions of textile patterns for the Jacquard loom (its data format would be adopted by IBM, almost unchanged, throughout the twentieth century). To be more precise, Watt's governor was turning the engine impulses into *abstract movement*, that is, constant rotary motion, and Jacquard's punched cards were turning manual instructions into *abstract form*, that is, information. Watt's governor and the Jacquard loom's punched cards—that is, control of motion and control of information—can be considered, in embryo, the first two anatomical components of the upcoming cybernetic system.[4] Throughout the Industrial Revolution, the bifurcating lineages of energy and information were already affecting one another and composing novel assemblages.

One may say that somehow both Marxism and environmentalism address the energetic component of capitalism: the former identifies it in the exploitation of human labor, the latter in the exploitation of natural resources. The "autonomy" of both labor and nature is used sometimes to unify the ground of "red" and "green" politics, but this *energy theory of labor* overlooks the role of information in the definition of both labor and nature. Whereas this section attempted to uncover the role of information within the industrial apparatus and the traditional definition of labor, the following section will show the hidden function of information in the constitution of the paradigm of ecology. Interestingly, both ecology and cybernetics will appear like the interweaving of the very same flows of energy and information—yet outside the factory.

Information, or the Government of Surplus

Conceptually, both ecology and cybernetics share roots in the notion of organism that is found in the German *Naturphilosophie* of the nineteenth century, where any "form of life" (from the animal to the nation-state) was understood as self-centered and in antagonism with the surrounding world (*Umwelt*). It was the zoologist and popular illustrator Ernst Haeckel (1866) who introduced the term *ecology* (*Ökologie*) as the study of the relation between organism and environment. The biologist Jakob von Uexküll (1920) described the relation between the animal's nervous system (*Innenwelt*) and the outside world (*Außenwelt*) as a "functional circle" (*Funktionskreis*)—a scheme that would later be repeated in the feedback loop of cybernetics. Similar to the *Funktionskreis*, the feedback loop of cybernetic systems was conceived as a circulation of information and response to an external stimulus. Uexküll viewed the organism as an information processing system struggling to adapt to the environment, similar to the adaptive model that influenced the early design of the "cybernetic brain" (Pickering 2010). Yet one should remember that Uexküll (as much as Marx) did not possess a notion of information: the mathematical definition of information would be formulated only by Claude Shannon (1948).

Another family trait common to ecology and cybernetics is the idea of conservative equilibrium and self-regulation (later on, this would be further consolidated in the notion of *homeostasis*).[5] There is a distinction to be made though: in ecology the medium of self-regulation appears to be the energy metabolism itself, whereas in cybernetics the medium of self-regulation is strictly assigned to information. The two paradigms converged from time to time and formed what is called *cybernetic ecology*. *The Whole Earth Catalog* published in California between 1968 and 1972 was a culminating example of this coevolution and, interestingly, a cultural pioneer of the following regime of production, the *network society* (see Bryant 2006; Turner 2010). For stressing the role of the infosphere in the control of the technosphere, the Anthropocene paradigm can also be considered part of the history of cybernetic ecology.

Historically, cybernetics originated from a mix of information theory and cognitive sciences that was heavily sponsored by military research (including the Manhattan Project in the construction of the first nuclear bomb). This essay illustrates cybernetics only in its coupling with the industrial apparatus: the *information flow* bifurcating out of the industrial machine encountered cybernetics and mainframe computers just after World War II.

As James Beniger (1986) shows in his book *The Control Revolution*, the paradigm of informationalism emerged through the continuous pressure of industrial production, in fact, out of a "crisis of control" of Western capitalism. A more and more *abstract* definition of information (i.e., measurable, computable, and transmissible knowledge) had to be introduced to manage the economic and commodity boom of the United States after World War II.

The cybernetic lineage that germinated out of the *information terminal* of the industrial machine aspired to control factories, national economies, and even the whole planet as its new self-reflexive organ, or *world brain*. Douglas Engelbart (1962) advanced the idea of machine-aided *augmented intellect* for problem solving even at the geopolitical scale. Stafford Beer (1972) would apply cybernetics to factory management with utopian enthusiasm: Salvador Allende's socialist government would invite him to develop the project Cybersyn with the purpose to regulate Chile's economy (which was, by the way, heavily based on copper extraction).[6] There is a lineage of cybernetics that was progressive: sometimes called social cybernetics, it influenced antipsychiatry movements and French philosophy too. Deleuze and Guattari (1987: 21) took the idea of *plateaus*, for instance, from the work of the English cybernetician Gregory Bateson on Balinese culture.[7]

With the original nucleus of ecology, cybernetics shared the idea of a self-regulating system based on information loops but applied this scheme to the design of intelligent machines. After World War II, during the so-called Great Acceleration (Steffen et al. 2015), industrial cybernetics was supposed to contain the overgrowth of production flows as a control apparatus. With the microchip revolution, the technologies of communication and control grew and transformed into a new vast nervous system, a *sentient technosphere* that today is escalating to the size of global data centers and the sophistication of machine learning algorithms. Cybernetics was also supposed to transform the economy into an ecology of feedback loops in order to control social unrest and potential revolutions. But homeostasis is a troublesome category when transplanted from biological to economic and institutional systems: in fact, capitalism keeps on expanding the use of fossil fuels and crunches ever-growing databases, feeding on metabolic surplus. As Beniger (1986) noted, the information revolution grew up (and keeps on growing) by feeding itself on the industrial and energetic surplus that it was supposed to measure and control. Equilibrium is rarely seen.

Cybernetics was thus the first *technopolitics*, that is, the first time a technological protocol was claimed as a protocol of political government (see Deutsch 1963). More exactly, cybernetics was the normative project of power in the age of information machines—a shift that Michel Foucault, but not Deleuze and Guattari, failed to record in his epistemology of power, although French philosophy (since the work of Simondon) was among the few early critical voices of the control paradigm of cybernetics. Marxism developed a critique of cybernetics too late, and Italian *operaismo* (workerism) started its inquiry on cognitive labor, not by chance, only after 1989. The only exemption may be the pioneering and forgotten work of Romano Alquati, who studied the division of labor at the Italian computer factory Olivetti as early as 1961 (!) and attempted to merge the notion of Marx's surplus value and cybernetic information under the concept of *valorizing information*. Alquati was probably the first to sketch an information theory of labor.

> The *productive labour* is defined by the quality of *information* elaborated and transmitted by the worker to the means of production via the mediation of constant capital, in a way that is tendentially indirect, but completely socialized. . . . Cybernetics recomposes globally and organically the functions of the general worker that are pulverized into individual microdecisions: the 'bit' links up the atomized worker to the figures of the Plan. (Alquati 1963; translated in Pasquinelli 2015: 55)

Autonomist Marxists like Alquati often stressed how social struggles and the refusal of labor accelerated industrial automation and the dissemination of information technologies. Labor resistance pushed the information revolution in the passage from Fordism to post-Fordism. But post-Fordism is not only the regime of the "hegemony of immaterial production";[8] it rose as a massive concentration of information, that is, knowledge and intelligence, on the side of capital, in fact, as a "control revolution" over industrial production (Beniger 1986). Post-Fordism is Fordism plus the databases of labor.

Computation, or the Encryption of Labor

Paul Edwards (2010) has illustrated how climate science and the computation of global warming are possible only thanks to a planetary network of sensors, data centers, and institutions that conceived and implemented mathematical models for data mining and forecasting. Surprisingly (or maybe not), the first picture of the "vast machine" of meteorological computation by John Ruskin (1839) resembled closely the "vast automaton" of the industrial factory described by Ure (1835). Ruskin's Meteorological Society appeared to be designed to mirror and second the central technological axis of the time, that is, the giant *automaton* that was orchestrating the division of manual and mental labor in the industrial factory.

> The Meteorological Society, therefore, has been formed not for a city, nor for a kingdom, but for the world. It wishes to be the central point, the moving power, of a vast machine, and it feels that unless it can be this, it must be powerless; if it cannot do all it can do nothing. It desires to have at its command, at stated periods, perfect systems of methodical and simultaneous observations; it wishes its influence and its power to be omnipresent over the globe so that it may be able to know, at any given instant, the state of the atmosphere on every point on its surface. (Ruskin 1839: 59)

The perception of the whole earth as ecosystem (as in the Gaia hypothesis) and the measurement of the Anthropocene are possible only through the most sophisticated information technologies. As much as the British Meteorological Society imitated the automaton of industrial capitalism qua control apparatus, today climate science institutions mirror the data centers of computational capitalism. With almost identical techniques, global data centers accumulate information and intelligence, not just about the world's climate but also about financial markets, logistical chains, international terrorism, and, more importantly, social networks of billions of individuals. Is the similarity of climate science and control apparatuses just a coincidence, or does it point to a more general form of governance?

The vast network of climate science appears like an extended cybernetic loop with big institutions taking the role of the nervous system of a pretty large organism—planet earth. The "vast machine" of the early climate science should be considered as the prototype of the *governance machine* of the Anthropocene, in which more and more metabolic flows and infrastructures are integrated and computed.[9] Climate science infrastructure and the Anthropocene technosphere emerge like the late twin of computational capitalism, in which computation appears to be oriented to the calculus of the planet's *surplus energy* rather than the calculus of *surplus labor*. Computation comes to give form to surplus, but one wonders if such a computation of surplus energy is just a way to mystify surplus labor. Since the "work/energy crisis" of the 1970s (Caffentzis [1980] 1992), we know that any definition and measure of energy affects the governance of labor. More generally, it looks as if we have surrendered the antagonism between labor, energy, and information to the Cybernetic Hypothesis (Tiqqun 2001), on one side, and the Anthropocene Hypothesis, on the other. The former postulates that life on the planet *is already* under the control of a totalitarian cybernetic apparatus, the latter that life on the planet *should be* under the control of a benevolent cybernetic apparatus. In both scenarios, computation is the adequate form of the paradoxical disappearance of labor, that is, *the ideological encryption of labor* within technology. It is necessary, then, to reveal labor again in the diagram of technology and, conversely, technology in the diagram of labor. The limit of current Marxism is the inability to recognize the new forms of *technified labor* and *technified subjectivities* that have lost any resemblance to the labor struggles of the past. In the mesh of global logistics and the algorithmic division of labor, new assemblages of labor must be recognized.

Carbosilicon Assemblages and Cyberfossil Capital

Any bifurcation is the birth of a new assemblage. And, in turn, any new assemblage expands previous bifurcations. In 1989, the same year the Berlin Wall fell and a decade before the much-celebrated rise of the network society, Guattari ([1989] 2013: 11) pictured "the age of planetary computerization" in his book *Schizoanalytic Cartographies*. This age was prophetically marked by a polyphony of technologies including new chemical compounds and even nuclear fusion energy but, more importantly, also artificial intelligence and large databases. According to Guattari, new subjectivities would be based on the computation of "enormous quantities of data" and biological engineering would remodel traditional living forms. In the same year, Guattari also published *The Three Ecologies* and recognized, in parallel, the ecological catastrophe driven by the hubris of technoscience. He writes: "The Earth is undergoing a period of intense techno-scientific transformations. If no remedy is found, the ecological disequilibrium this has generated will ultimately threaten the continuation of life on the planet's surface" (Guattari [1989] 2000: 27).

The contrast between the potentiality of computation and the damages of the technosphere has become manifest today, with global data centers accelerating networks of logistics, the extraction of natural resources (often in the global South), and fossil fuel emissions worldwide. The incestuous relation between planetary control and planetary disequilibrium is the riddle at stake in the hiatus between the Cybernetic Hypothesis and the Anthropocene Hypothesis, the civilizations of Silicon and Carbon, the lineages of Information and Energy, as illustrated throughout this essay. The relation between the chimera's two heads of Energy and Information happened to be a turbulent double bind: of mutual amplification (in the game of capital) but also of containment (in the game of politics). Rather than reiterating the opposition of monotonic paradigms, it may be better to try and consolidate the assemblage of energy and information into new systemic notions.

The idea of the *carbosilicon machine* is proposed to describe the historical assemblage of the industrial and information apparatuses, the grafting of the Turing machine onto the governor of the thermodynamic engine. The carbosilicon machine is but the cypher of the technosphere, which seals the molecular imbrication of manual and mental labor that is often overlooked. If Babbage's Analytical Engine, now acknowledged as the first stored-program computer, was "a projection of a more perfect factory" (Mirowski 2002: 34), any Turing machine should be considered an overall *dispositif* for the logistics of mental and manual labor as well as that of matter and energy. At a planetary scale, the coupling of energy and information is obvious in the colonial relation between the data centers of the logistics companies of the global North and the extractive industries in the global South. The "Technosphere of the Anthropocene" is therefore the name given to the globalization of the old colonial factory, still waiting to find the present-day Babbage and Marx.

The notion of the *carbosilicon machine* may help to decouple and repurpose technology from its colonial and monopolistic destiny and, more importantly, to illuminate new forms of struggle and resistance. Such a clarification is especially hard nowadays due to the double crisis of the Carbon and Silicon regimes: the environmental and energetic crisis, on the one hand, and the crisis of valorization triggered by digital technologies, on the other, have galvanized political fronts that strive to merge. Critical thought, and specifically Marxism, has never tried, in this respect, to unite the lineages of energy and information into a synthetic definition of labor. Everything can be easily described under the hegemony of *financial capitalism*, but *fossil capitalism* and *cognitive capitalism* are still waiting to be integrated. Such a theoretical weakness is mirrored by a sort of "bifurcation" that happens to social struggles too. The disconnect between information-related struggles (from the hacker movement to the digital precariat, from Anonymous to media activism in the post–Edward Snowden age) and energy-related struggles (from antinuclear movements to climate justice, from urban ecology to indigenous struggles on land and sovereignty) is evident. To use an old topos of the autonomist thought: a new *political composition* of energy and information must be thought against the *technical composition* that bifurcated them since the industrial age.

How might we address social autonomy in the age of the planetary automaton? Ironically, the *automaton* of the technosphere (as in Haff 2014) appears to absorb and reverse the *autonomy* of social movements and workers' struggles of the 1960s and 1970s as much as the network cultures of the 1990s to 2010s (themselves easily captured by the new social monopolies of the Internet). The technological form absorbs features that once belonged to the social form. It may be wise to clarify here that *automaton* means "capable of independent motion," whereas *autonomy* means "self-governing and able to invent new laws, rules, and habits." Automation is the imitation of old rules; autonomy is the invention of new ones. This is why Langdon Winner (1977: 16) says that the expression "autonomous technology" is ironic, because technical objects seem to supplant the freewill of subjects. To rethink social autonomy today one has to see what the autonomy of energy and the autonomy of information mean together in an expanded (and technified) notion of labor.

Eventually the designation of carbosilicon machine summons the demons of its historical proliferation and logically bespeaks the birth of the regime of *cyberfossil capitalism*—a regime that has implemented energy and information qua abstract equivalents as much as labor and money. The imbrication of energy and information flows is not new to philosophy. In their reading of the "Fragment on Machines" in *Grundrisse* (Marx [1939] 1993: 690–712), Deleuze and Guattari (1983: 232) recognized a *machinic surplus value* that was distinguished into a *surplus value of flow* (labor, energy) and a *surplus value of code* (information, knowledge). Accordingly, late computational capitalism should be defined as an abstract machine that divides labor in flows of energy and information and manages their synthesis qua real abstractions. Cyberfossil capitalism is the metabolism of the most archaic biosphere and the most abstract technosphere united by capital.

Notes

1 The term *outcryption* refers to something that is invisible and inaccessible for being encoded, paradoxically, in public procedures, common habits, and social techniques: it is historically the nonconscious yet very empirical power of any ideology.

2 Orthodox Marxists will pardon, for once, the ambivalent use of the notion of abstract labor in this passage. In Marx, abstract labor refers to human activity that is calculated and valorized by capital as the universal equivalent. Here it points also to the cognitive and informational component of labor in general. Alfred Sohn-Rethel (1978) would find that the two dimensions are genealogically related.

3 The fossil fuel economy will be further "abstractified" by capital with the introduction of carbon credit trading. See Leonardi 2014.

4 Norbert Wiener (1948: 11) coined the term *cybernetics* from the Greek *kybernetes* (governor/steersman), also drawing on Clerk Maxwell's 1868 article "On Governors."

5 It is worth noting that Haeckel and Uexküll embraced reactionary political positions, as did a good part of the German *Lebensphilosophie*, not to mention Martin Heidegger. See Harrington 1999.

6 On the Cybersyn project, see Medina 2011. It must be noted that Cybersyn was contemporary to the Advanced Research Projects Agency Network, or ARPANET (progenitor of the Internet), which was developed by the US Department of Defense. ARPANET

was conceptually far more advanced than Cybersyn for implementing a decentralized architecture based on packet-switching communication.

7 In general, Deleuze and Guattari's notion of *machinic* is indebted to the open framework inaugurated by cybernetics that aimed to dissolve the border between organic systems and technical systems (and between vitalism and mechanicism).

8 On the hegemony of immaterial production, see Hardt and Negri 2004: 103–15.

9 In fact, the metabolism of the global technosphere is incredibly complex: it comprises the cycles of chemical compounds such as agricultural nitrogen and rare earth, for instance, and not just fossil carbon. Peter Haff (2014) describes the technosphere as a humungous automaton and proposes six rules to frame the fatal destiny of the human outclassed by the metabolism of technology: inaccessibility, impotence, control, scale, performance, and provision (curiously grounding in this way the principles of *anticybernetics*, as this looks like a theory of noncontrol).

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