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Markets and Antimarkets in the World Economy

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One of the most significant epistemological events in recent years is the growing importance of historical questions in the ongoing reconceptualization of the hard sciences. I believe it is not an exaggeration to say that, in the last two or three decades, history has almost completely infiltrated physics, chemistry, and biology. It is true that nineteenth-century thermodynamics had already introduced an arrow of time into physics from which arose the idea of irreversible historical processes. It is also true that the theory of evolution had already shown that animals and plants were not embodiments of eternal essences but piecemeal historical constructions, slow accumulations of adaptive traits cemented together via reproductive isolation. The classical versions of these two theories, however, incorporated a rather weak notion of history into their conceptual machinery: both thermodynamics and Darwinism admitted only one possible historical outcome, the reaching of thermal equilibrium or of the fittest design. In both cases, once this point was reached, historical processes ceased to count. For these theories, optimal design or optimal distribution of energy represented, in a sense, an end of history.

It should come as no surprise that the current penetration of science by history has been the result of advances in these two disciplines. Ilya Prigogine revolutionized thermodynamics in the 1960s by showing that the classical results were only valid for closed systems where the overall amounts of energy are always conserved. If one allows energy to flow in and out of a system, the number and type of possible historical outcomes greatly increases. Instead of a unique and simple equilibrium, we now have multiple ones of varying complexity (static, periodic, and chaotic atractors); and moreover, when a system switches from one to another form of stability (at a so-called bifurcation), minor fluctuations can be crucial in deciding the actual form of the outcome. When we study a given physical system, we need to know the specific nature of the fluctuations that have been present at each of its bifurcations. In other words, we need to know its exact history to understand its current dynamical form (Prigogine and Stengers, 1984: 169).

And what is true of physical systems is all the more true for biological ones. Atractors and bifurcations are features of any system in which the dynamics are nonlinear, that is, where there are strong interactions between variables. As biology begins to include these nonlinear dynamical phenomena in its models (as in the case of evolutionary arms races between predators and prey) the notion of a "fittest design" loses its meaning. In an arms race, there is no optimal solution fixed once and for all, since the criterion of fitness itself changes with the dynamics. This is also true for any adaptive trait whose value depends on how frequently it occurs in a given population, as well as in cases like migration, where animal behavior interacts nonlinearly with selection pressures. As the belief in a fixed criterion of optimality disappears from biology, real historical processes come to reassert themselves once more (Kauffman, 1988: 280).

Computers have played a crucial role in this process of infiltration. The nonlinear equations that go into these new historical models cannot be solved by analytical methods alone, and so scientists need computers to perform numerical simulations to and discover the behavior of the resulting solutions. But perhaps the most crucial role of digital technology has been to allow a switch from a purely analytic, top-down style of modeling, to a more synthetic, bottom-up approach. In the growing discipline of Artificial Life (Al), for instance, an ecosystem is not modeled starting from the whole and dissecting it into its component parts, but the other way around: one begins at the bottom, with a population of virtual animals and plants and their local interactions, and the ecosystem needs to emerge spontaneously from these local dynamics. The basic idea is that the systematic properties of an ecosystem arise from the interactions between its animal and plant components, so that when one dissects the whole into parts the first thing one loses is any property due to these interactions. Analytical techniques, by their very nature, tend to kill emergent properties, that is, properties of the whole that are more than the sum of its parts. Hence the need for a more synthetic approach, in which

everything systematic about a given whole is modeled as a historically emergent result of local interactions (Langton, 1989: 2).

These new ideas are all the more important when we move on to the social sciences, particularly economics. In this discipline, we tend uncritically to assume systematicity, as when one talks of the "capitalist system," instead of showing exactly how such systematic properties of the whole emerge from concrete historical processes. We then tend to reify such unaccounted-for systematicity by ascribing all kinds of causal powers to capitalism, to the extent that a clever writer can make it seem as if anything at all (from nonlinear dynamics itself to postmodernism or cyberculture) is the product of late capitalism. Such indiscriminate reification is, I believe, a major obstacle to a correct understanding of the nature of economic power, and is partly the result of the purely top-down, analytical style that has dominated economic modeling from the eighteenth century. Both macroeconomics, which begins at the top with concepts like gross national product, as well as microeconomics, in which a system of preferences guides individual choice, are purely analytical in approach. Neither the properties of a national economy nor the ranked preferences of consumers are shown to emerge from historical dynamics. Marxism added to these models intermediate scale phenomena, like class struggle, and with it, conflictive dynamics. But the specific way in which it introduced conflict, via the labor theory of value, has now been shown by Shraffa to be redundant, added from the top, so to speak, and not emerging from the bottom, from real struggles over wages, or the length of the working day, or for control over the production process (Hodgsen, 1981: 93).

What we need here is a return to the actual details of economic history that utilizes a synthetic approach, as is happening, for instance, in the evolutionary economics of Nelson and Winter, where their emphasis is on populations of organizations interacting nonlinearly. Much has been learned in recent decades about these details, thanks to the work of materialist historians like Fernand Braudel, and it is to this historical data that we must turn to know what we need to model synthetically. Nowhere is this need for real history more evident than in the subject of the dynamics of economic power, defined as the capability to manipulate the prices of inputs and outputs of the production process as well as their supply and demand. In a peasant market, or even in a small-town, local market, everybody involved is a price-taker: one shows up with merchandise and sells it at the going prices, which reflect demand and supply. But monopolies and oligopolies are price-setters: the prices of their products need not reflect demand/supply dynamics, but rather their own power to control a given market share (Galbraith, 1978: 24).

previous essay? nice job!

When approaching the subject of economic power, one can safely ignore the entire field of linear mathematical economics (so-called competitive equilibrium economics), since these fields basically ignore monopolies and oligopolies. Indeed, Herbert Simon, economist and Artificial Intelligence guru, called this lack of concern for power the scandal of modern economics. Yet even those thinkers like Mandel or Galbraith who make economic power the center of their models, introduce it in a way that ignores historical facts. Authors writing in the Marxist tradition place real history in a straitjacket by subordinating it to a model of a progressive succession of modes of production. Capitalism itself is seen as maturing through a series of stages, the latest one of which is the monopolistic stage in this century. Even non-Marxist economists like Galbraith agree that capitalism began as a competitive pursuit, stayed that way until the end of the nineteenth century, and only then reached the monopolistic stage, at which point a planning system replaced market dynamics.

However, Fernand Braudel has recently shown, with a wealth of historical data, that this picture is inherently wrong. Capitalism was, from its beginnings in the Italy of the thirteenth century, always monopolistic and oligopolistic. That is to say, the power of capitalism has always been associated with large enterprises, large that is, relative to the size of the markets where they operate (Braudel, 1982, 2: 229). Also, it has always been associated with the ability to plan economic strategies and to control market dynamics, and therefore, with a certain degree of centralization and hierarchy. Within the limits of this article, I will not be able to review the historical evidence that supports this extremely important hypothesis, but allow me at least to extract some of the consequences that would follow if it turns out to be true.

First of all, if capitalism has always relied on noncompetitive practices, if the prices for its commodities have never been objectively set by demand/supply dynamics, but imposed from above by powerful economic decision-makers, then capitalism and the market have always been different entities. To use a term introduced by Braudel, capitalism has always been an "antimarket." Such a reconceptualization would seem to go against the very meaning of the word "capitalism," regardless of whether the word is used by Karl Marx or Ronald Reagan. For both nineteenth-century radicals and twentieth-century conservatives, capitalism is identified with an economy driven by market forces, whether one finds this desirable or not. Today, for example, one speaks of the former Soviet Union's "transition to a market economy," even though what was really supposed to happen was a transition to an antimarket—to large-scale enterprises with several layers of managerial strata in which prices are set. This conceptual confusion is so entrenched that I believe

the only solution is to abandon the term "capitalism" completely, and to begin speaking of markets and antimarkets and their dynamics.

Utilizing this new terminology would have the added advantage of allowing us to get rid of historical theories framed in terms of stages of progress and to recognize the fact that antimarkets could have arisen anywhere. Theoretically, antimarkets can arise the moment the flows of goods through markets reach a certain critical level of intensity, so that organizations bent on manipulating these flows can emerge. Hence, the birth of antimarkets in Europe has absolutely nothing to do with a peculiarly European trait, such as rationality or a religious ethic of thrift. As is well known today, Europe borrowed most of its economic and accounting techniques, those techniques that are supposed to distinguish her as uniquely rational, from Islam (Braudel, 1982, 2: 559–61). Many of the technological inventions that allowed her economy to take off came from China. What needs explaining is not that antimarkets were born in Europe, but that they did not emerge in the economies of China or Islam, even though the volume of trade there was intense enough. Several historians explain this situation by invoking the repressive power of their respective states, which made large-scale accumulation of capital impossible (McNeill, 1982: 49).

Finally, and before we take a look at what a synthetic, bottom-up approach to the study of economic dynamics would be like, let me meet a possible objection to these remarks: the idea that "real" capitalism did not emerge until the nineteenth-century Industrial Revolution, and that it could not have arisen anywhere else where these specific conditions did not exist. To criticize this position, Fernand Braudel has also shown that the idea that capitalism goes through stages, first commercial, then industrial, and finally financial, is not supported by the available historical evidence. Venice in the fourteenth century and Amsterdam in the seventeenth, to cite only two examples, already showed the coexistence of the three modes of capital in interaction. Moreover, other historians have recently shown that the specific form of industrial production which we tend to identify as "truly capitalist," that is, assembly line mass production, was not born in economic organizations, but in military ones, beginning in France in the eighteenth century, and then in the United States in the nineteenth century. It was military arsenals and armories that gave birth to these particularly oppressive control techniques of the production process, at least a hundred years before Henry Ford and his Model T cars. (Smith, 1987: 47). This largely ignored military component of large-scale enterprises is, I believe, another good reason to replace the term "capitalism" with a neologism like "the antimarket," since we can simply build this military component right into our definition of the term.

Besides conceptual clarification of its terms, economics needs novel approaches to modeling in order to complement analysis of its concepts with synthesis of the emergent properties of the phenomena with which it concerns itself. What would the models created by a bottom-up approach to the evolution of economics look like? A convenient starting point for a description of such a complex simulation is provided by the work of Nelson and Winter on evolutionary economics. In their work, they begin at the bottom, at the level of the individual firm. Why not even lower, at the level of human individuals? Because one important insight of their research is that large organizations, having developed routine procedures to handle many decisions, strongly constrain the choices of individual decision-makers, at least in most of the daily operations of the firm. These routines function as an "organizational memory" that maintains the identity of the firm from day to day. When a firm opens up a branch, for example, it moves some of its staff to that branch and a more-or-less accurate copy of this memory is transferred with them (Nelson and Winter, 1982: 98). Hence, the large firms that make up the antimarket can be seen as replicators, much as animals and plants are. And in populations of such replicators, we should be able to observe the emergence of the different commercial forms, from the family firm, to the limited liability partnership, to the joint stock company. These three forms, which had already emerged by the fifteenth century, must be seen as arising, like those of animals and plants, from slow accumulations of traits that later become consolidated into more-or-less permanent structures, and not, of course, as manifestations of some preexisting essence. In short, both animal and plant species as well as "institutional species" are historical constructions, the emergence of which bottom-up models can help us study.

It is important to emphasize that we are not only dealing with biological metaphors here. Any kind of replicating system that produces variable copies of itself when coupled with any kind of sorting device is capable of evolving new forms. This basic insight is now exploited technologically in the so-called "genetic algorithm," which allows programmers to breed computer software instead of painstakingly coding it by hand. A population of computer programs is allowed to reproduce with some variation, and the programmer plays the role of a sorting device, steering the population towards the desired form. The same idea is what makes AL (Artificial Life) projects work. Hence, when we say that the various forms the antimarket has taken are evolved historical constructions, we do not mean to limit our analysis to suggesting a simple metaphorical likeness to organic forms. Indeed, we argue that the divergent manifestations of the antimarket are produced by a process that embodies the same engineering diagram as the one that generates organic

forms. Another example may help to clarify this. When one says, as leftists used to say, that "class struggle is the motor of history," one is using the word "motor" in a metaphorical way. On the other hand, to say that a hurricane is a steam motor is not to use the term metaphorically, but literally: one is saying that the hurricane embodies the same engineering diagram as a steam motor: it uses a reservoir of heat, and operates via differences of temperature circulated through a Carnot cycle. The same is true of the genetic algorithm. Anything that replicates, such as patterns of behavior transmitted by imitation, or rules and norms transmitted by enforced repetition can give rise to novel forms when populations of them are subjected to selection pressures. And the traits that are thus accumulated can become consolidated into a permanent structure by codification, as when informal routines become written rules (Dawkins, 1989).

In this case, we have the diagram of a process that generates hierarchical structures, whether large institutions rigidly controlled by their rules or organic structures rigidly controlled by their genes. There are, however, other structure-generating processes that result in decentralized assemblages of heterogeneous components. Unlike a species, an ecosystem is not controlled by a genetic program; it integrates a variety of animals and plants in a food web by interlocking them together into what has been called a "meshwork structure." The dynamics of such meshworks are currently under intense investigation, and something like their abstract diagram is beginning to emerge (Kaufmann, 1988). From this research, it is becoming increasingly clear that small markets, that is, local markets without too many middlemen, embody this diagram; they allow the assemblage of human beings by interlocking complementary demands. These markets are self-organized, decentralized structures: they arise spontaneously without the need for central planning. As dynamic entities they have absolutely nothing to do with an "invisible hand," since models based on Adam Smith's concept operate in a frictionless environment in which agents have perfect rationality and all information flows freely. Yet, by eliminating nonlinearities, these models preclude the spontaneous emergence of order, which depends crucially on friction: delays, bottlenecks, imperfect decision-making, and so on.

The concept of a meshwork can be applied not only to the area of exchange, but also to that of industrial production. Jane Jacobs has created a theory of the dynamics of networks of small producers meshed together by their interdependent functions, and has collected some historical evidence to support her claims. The basic idea is that certain relatively backward cities in the past—Venice when it was still subordinated to Byzantium, or the network New York-Boston-Philadelphia when still a supply zone for the British empire—

engaged in what she calls "import-substitution dynamics." Because of their subordinated position, they must import most manufactured products, and export raw materials. Yet meshworks of small producers within the city, by interlocking their skills, can begin to replace those imports with local production, and these imports can then be exchanged with other backward cities. In the process, new skills and new knowledge are generated, new products begin to be imported that become the raw materials for a new round of import-substitution. Nonlinear computer simulations of this process have been created, and they confirm Jacobs's intuition: a growing meshwork of skills is a necessary condition for urban morphodynamics. The meshwork as a whole is decentralized, and it does not grow by planning, but by a kind of creative drift (Jacobs, 1984: 133).

Of course, this dichotomy between command hierarchies and meshworks should not be taken too rigidly; in reality, once a market grows beyond a certain size, it spontaneously generates a hierarchy of exchange, with prestige goods at the top and elementary goods, like food, at the bottom. Command structures, in turn, generate meshworks, as when hierarchical organizations created the automobile, and then a meshwork of services (repair shops, gas stations, motels, and so on) grew around it.[1] More importantly, one should not romantically identify meshworks with that which is "desirable" or "revolutionary," since there are situations where they increase the power of hierarchies. For instance, oligopolistic competition between large firms is sometimes kept away from price wars by the system of interlocking directorates, in which representatives of large banks or insurance companies sit on the boards of directors of these oligopolies. In this case, a meshwork of hierarchies is almost equivalent to a monopoly (Munkirs and Sturgeon, 1989: 343). And yet, however complex the interaction between hierarchies and meshworks, the distinction is real; the former create structures out of elements sorted out into homogenous ranks, the latter articulate heterogeneous elements as such, without homogenization. A bottom-up approach to economic modeling should represent institutions as varying mixtures of command and market components, perhaps in the form of combinations of negative feedback loops, which are homogenizing, and positive feedback, which generates heterogeneity.

What would one expect to emerge from such populations of more-or-less centralized organizations and more-or-less decentralized markets? The answer is, a world-economy, or a large zone of economic coherence.[2] The term, which should not be confused with that of a global economy, was later adapted by Braudel so as not to depend on a conception of history in terms of a unilineal progression of modes of production. Braudel takes the spatial definition of a world-economy from Wallerstein, and defines it as an economically

autonomous portion of the planet—perhaps coexisting with other such regions—with a definite geographical structure. It is composed of a core of cities that dominate it and that are surrounded by yet other economically active cities, subordinated to the core and forming a middle zone, and finally a periphery of completely exploited supply zones. The role of European world-economy's core has been historically played out by several cities: first Venice in the fourteenth century, followed by Antwerp and Genoa in the fifteenth and sixteenth. Amsterdam then dominated it for the next two centuries, followed by London and then New York. Today, we may be witnessing the end of American supremacy, and the role of core seems to be moving to Tokyo (Braudel, 1982, 3: 25–38).

Interestingly, those cities that play the role of core seem to generate very few large firms. For instance, when Venice played this role, no large organizations emerged in it, even though they already existed in nearby Florence. Does this absence of large-scale firms contradict the thesis that capitalism has always been monopolistic? I think not. What happens is that, in this case, Venice as a whole played the role of a monopoly: it completely controlled access to the spice and luxury markets in the Levant. Within Venice, everything seemed like "free competition," and yet its rich merchants enjoyed tremendous advantages over any foreign rival, whatever its size. Perhaps the impression classical economists had of a competitive stage of capitalism comes from the fact that the Dutch or the British advocated "free competition" internally precisely when their cities as a whole held a virtual monopoly on world trade.

World-economies, then, present a pattern of concentric circles around a center, defined by relations of subordination. To this spatial structure, Wallerstein and Braudel add a temporal one: a world-economy expands and contracts in a variety of rhythms of different lengths: from short-term business cycles to longer-term Kondratiev cycles, which last approximately fifty years. While the domination by core cities gives a world-economy its spatial unity, these cycles give it a temporal coherence: prices and wages move in unison over the entire area. Prices are, of course, much higher at the center than at the periphery, and this fact makes everything flow towards the core: Venice, Amsterdam, London, and New York, as they took their turn as dominant centers, became "universal warehouses" where one could find any product from anywhere in the world. And yet, while respecting these differences, all prices moved up and down following these nonlinear rhythms, affecting even those firms belonging to the antimarket, firms that needed to consider those fluctuations when setting their own prices.

These patterns—self-organized in time and space—which define world-economies were first discovered in analytical studies of historical data.

The next step is to use synthetic techniques, and create the conditions under which they can emerge in our models. In fact, bottom-up computer simulations of urban economics, where spatial and temporal patterns spontaneously emerge, already exist. For example, Peter Allen has created simulations of nonlinear urban dynamics as meshworks of interdependent economic functions. Unlike earlier mathematical models of the distribution of urban centers, which assumed perfect rationality on the part of economic agents, and where spatial patterns resulted from the optimal use of some resource such as transportation, here patterns emerge from a dynamic of conflict and cooperation. As the flows of goods, services and people in and out of these cities change, some urban centers grow, while others decay. Stable patterns of coexisting centers arise as bifurcations occur in the growing city networks taking them from attractor to attractor (Allen, 1982: 136).

According to Braudel, something like Allen's approach would be useful to model one of the two things that stitch world-economies together—trade circuits. To generate the actual spatial patterns that we observe in the history of Europe, however, we need to include the creation of chains of subordination among these cities, of hierarchies of dependencies besides the meshworks of interdependencies. This would require the inclusion of monopolies and oligopolies, growing out of each city's meshworks of small producers and traders. We would also need to model the extensive networks of merchants and bankers (through which dominant cities invaded their surrounding urban centers) by converting them into a middle zone at the service of the core. A dynamical system of trade circuits, animated by import-substitution dynamics within each city, and networks of merchants extending the reach of large firms of each city may be able to give us some insight into the real historical dynamics of the European economy (Braudel, 1982, 3: 140–67).

Bottom-up economic models that generate temporal patterns have also been created. One of the most complex simulations in this area is the Systems Dynamics National Model at MIT. Unlike econometric simulations, where one begins at the macroeconomic level, this one is built up from the operating structure within corporations. Production processes within each industrial sector are modeled in detail. The decision-making behind price-setting, for instance, is modeled using the know-how of real managers. The model includes many nonlinearities normally dismissed in classical economic models, such as delays, bottlenecks, and the inevitable friction due to bounded rationality. The simulation was not created with the purpose of confirming the existence of the Kondratiev wave, the fifty-two-year cycle that can be observed in the history of wholesale prices for at least two centuries. In fact, the designers of the model were unaware of the literature on the subject. Yet, when the simulation began to unfold, it reached a bifurcation and a periodic attractor emerged in the system, which began pulsing to a fifty-year beat. The crucial element in this dynamics seems to be the capital goods sector, the part of the industry that creates the machines that the rest of the economy uses. Whenever an intense rise in global demand occurs, firms need to expand and then to order new machines. But when the capital goods sector, in turn, expands to meet this demand, it needs to order from itself. This creates a positive feedback loop that pushes the system towards a bifurcation (Sterman, 1989).

Insights coming from running simulations like these can, in turn, be used to build other simulations, and to suggest directions for historical research to follow. In the near future we will be able to imagine parallel computers running simulations combining all the insights from the ones we just discussed: spatial networks of cities, breathing at different rhythms and housing evolving populations of organizations and meshworks of interdependent skills. If power relations are included, monopolies and oligopolies will emerge, and we will be able to explore the genesis and evolution of the antimarket. If we include the interactions between different forms of organizations, then the relationships between economic and military institutions may be studied. As Galbraith has pointed out, in today's economy nothing goes against the market, nothing is a better representative of the planning system, as he calls it, than the military-industrial complex (Galbraith, 1978: 321). But we would be wrong in thinking that this is a modern phenomenon, something caused by "late capitalism."

In the first core of the European world-economy, thirteenth-century Venice, the alliance between monopoly power and military might was already in evidence. The Venetian arsenal, where all the merchant ships were built, was the largest industrial complex of its time. We can think of these ships as the fixed capital, the productive machinery of Venice, since they were used to do all the trade that kept her powerful; but at the same time, they were military machines, used to enforce her monopolistic practices (Braudel, 1982, 2: 444). When Amsterdam and London came to be the core, the famous companies of India with which they conquered the Asian world-economy, transforming it into a periphery of Europe, were also hybrid military-economic institutions. We have already mentioned the role that French armories and arsenals, in the eighteenth century, and American ones, in the nineteenth century, played in the birth of mass-production techniques. Frederick Taylor, the creator of the modern system for the control of the labor process, learned his craft in military arsenals. That nineteenth century radical economists did not understand this hybrid nature of the antimarket can be seen from the fact that Lenin himself welcomed Taylorism into revolutionary Russia as a progressive force, instead of seeing for what it was: the imposition of a rigid command-hierarchy on the workplace.

Unlike these thinkers, to correctly model the hybrid economic-military structure of the antimarket, we should include in our simulations all the institutional interactions that historians have uncovered. Perhaps by using these synthetic models as tools of exploration, as intuition synthesizers, so to speak, we will also be able to study the feasibility of counteracting the growth of the antimarket by a proliferation of meshworks of small producers. Multinational corporations, according to the influential theory of "transaction costs," grow by swallowing up meshworks, by internalizing markets either through vertical or horizontal integration (Hennart, 1991). They can do this because of their enormous economic power (most of them are oligopolies) and their access to intense economies of scale. However, meshworks of small producers interconnected via computer networks could have access to different, but just as intense, economies of scale. A well-studied example is the symbiotic collection of small textile firms that has emerged in an Italian region between Bologna and Venice. The operation of a few centralized textile corporations was broken down into a decentralized network of firms, in which entrepreneurs replaced managers, and short runs of specialized products replaced large runs of mass-produced ones. Computer networks allowed these small firms to react flexibly to sudden shifts in demand, so that no firm became overloaded while others sat idly with spare capacity (Malone and Rockart, 1991, 131; Jacobs, 1984: 40; Braudel, 1982, 3: 630).

But more importantly, a growing pool of skills is thereby created, and because this pool has not been internalized by a large corporation, it can not be taken away. Therefore, this region will not suffer the fate of so many American company towns, which die after the corporation that feeds them moves elsewhere. These self-organized reservoirs of skills also explain why economic development cannot be exported to the Third World via large transfers of capital invested in dams or other large structures. Economic development must emerge from within as meshworks of skills grow and proliferate (Jacobs, 1984: 148). Computer networks are an important element here, since the savings in coordination costs that multinational corporations achieve by internalizing markets can be enjoyed by small firms through the use of decentralizing technology. Computers may also help us to create a new approach to control within these small firms. The management approach used by large corporations was in fact developed during World War II under the name of Operations Research. In much the same way as mass-production techniques effected a transfer of a command-hierarchy from military arsenals to civilian factories, management practices based on linear analysis carry with them the centralizing tendencies of the military institutions where they were born. Nonlinear scientists are now developing fresh approaches to these questions

in which the role of managers is not to impose preconceived plans on workers, but to catalyze the emergence of meshworks of decision-making processes among them (Malik and Probst, 1984: 113). Computers, in the form of embedded intelligence in the buildings that house small firms, can aid this catalytic process, allowing the firms' members to reach some measure of self-organization. Although these efforts are in their infancy, they may one day play a crucial role in adding some heterogeneity to a world-economy that is becoming increasingly homogenized.

Notes

1. The dichotomy meshwork/hierarchy is a special case of what Deleuze and Guatteri call Smooth/Striated or Rhizome/Tree.
2. The term "world-economy" is a neologism of Immanuel Wallerstein.

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11

Technoscience and the Labor Process

William DiFazio

I am going to tell a few stories of work and nonwork in postindustrial, postmodern, now-Clintonesque America. And I am going to point in some directions that I believe intellectual activists should move in. These directions can, at this point, be only provisional, because the labor process, transformed by technoscience, has changed the world of work and the social and cultural relations that are part of the world of work.

This presentation consists of fragmented and incomplete narratives, which I call stories, that describe a world of work that is increasingly "up for grabs." So far all of the grabbing has been on the terms of those who own and control the technoscience-based labor process.

The First Story: Empty Piers

Longshoremen on the Guaranteed Annual Income (GAI) are paid even after their work is technologically redundant. The GAI came about as a result of technological changes within the shipping industry. The union's premise was that the cost of technological changes should not rest entirely upon the employees in the industry. The longshoremen are guaranteed work or income; containerization of cargo might eliminate their jobs, but it would not eliminate their incomes.