Speculative capital and the ecosystem of globalization

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Introduction

It is difficult to read the stream of reports from the United Nations and other organizations about the planet's non-human environment without recognizing that a profound transformation is taking place (e.g., United Nations Environment Programme (UNEP), 1999; IPCC, 2001; World Resources Institute, 2005; UNEP, 2006). Over in the economic, social and cultural realms equally profound changes, lumped into the general category of "globalization", are taking place. How, if at all, are these two powerful currents -- environmental change and globalization -- related? The strength of the connection has important implications -- not just to help us understand the twin (or single?) processes, but also help to chart solutions to the profound challenges posed by these processes.

This paper starts from two premises: that globalization represents a new stage of capitalism, and that as society moves across modes of production and stages within those modes, "ecological revolutions" take place that result in new, corresponding ecosystems. From these two premises, it follows that an ecosystem of globalization is forming out of, and helping to form, the economic, political, social and cultural processes of globalization. This paper will explore this hypothesis, using speculative capital associated with globalization as the entry point. The resulting ecosystem cannot be separated from globalization. While globalization is not a "choice" within the law system of capitalism, it is a choice in the broad historical sense of how production will be organized. The future of the environment is tied to this same choice.

Globalization and environmental history

Within the field of global studies, there has been an ongoing debate what exactly globalization is. Liodakis (2005) identifies three main currents. The "conventional" view accepts globalization as a new trend, but views it as an optional social and policy choice. There are four variants of "conventionalists". The pessimistic conservative view fears the loss of nationalist identity and control. The optimistic conservative view embraces neoliberalism -- open markets, the free flow of capital, a shrunken, hands-off government. Pessimistic liberals bemoan the passing of the welfare state and Keynesian economic controls. Optimistic liberals embrace neoliberalism, but push for temperance through global regulators. The second main current, the "denialist" current, denies that globalization represents anything new -- it is just a continuation of existing historic trends with a new name. In this camp one can include world systems theory (per Robinson, 2004), the *Monthly Review* editorial board (Sivanandan and Wood, 1997; Henwood, 2001) and recent popular treatments like Frieden (2006). The third current, the "epochal shift" or "global capitalism school" current, sees globalization as a new stage of capitalism, combining both the recognition of it as *capitalism*, and as something new and different. (Davis, 1998; Burbach and

Robinson, 1999; Robinson, 2004; Liodakis, 2005)

The "global capitalism school" assumes a periodization of capitalism, which itself has been the subject of debate. Periodization, as Robinson notes (2004), is an analytical device for highlighting features of particular stages. Liodakis (2005) argues that "mode of production" should distinguish periods; and Robinson uses a similar framework, with both arriving at similar periods: mercantile capitalism (Liodakis omits this); industrial or competitive capitalism beginning in the late 1700s; monopoly capitalism or imperialism beginning in the late 1800s; and global capitalism or globalization beginning in the early 1970s, although one can argue that the transition began with the end of World War II, and flowers in the 1970s (Davis, 2005). The "global capitalism school" argues that globalization is an "epochal shift" from a "world economy", characterized by the internationalization of trade and finance, to a "global economy" where *production* is also internationalized (or transnationalized). It is still capitalism, but significantly, perhaps qualitatively, different because of this transnationalization of production. Globalization features the completion of the geographic expansion of capitalism, where expansion takes place through the *intensification* of the market, including the commodification or marketization of every aspect of social life, and where every human being is pulled into capitalist relations in some way (Robinson, 2004). Since this new stage emerges with (and is dependent on) new technologies that can be lumped into the general category of "electronics"[1], "global capitalism" can also be thought of as "capitalism in the age of electronics." (Davis, 1997) It is in this sense that the term "globalization" will be used from here on.[2]

The concept of periodization has also played an important role in the discipline of environmental history. Environmental history seeks to understand how human interactions change the environment, and how non-human environment changes humans throughout history (Hughes, 2001). As such, environmental history supercedes many histories, including economics, cultural studies, philosophy, and technology -- it becomes a "culmination of all previous history" (O'Connor, 1998, p. 51). Typically, the periods span the entire *Homo sapiens* era, with broad modes of production (hunting/gathering; manual agricultural; industrial) having corresponding changes in the ecosystem (Simmons, 1993). At the boundaries of modes of production, Merchant (1989) argues that there are "ecological revolutions" that include changes in the human - nature relationship (understanding of nature, what it is, how it is represented, participation or alienation, etc.) as well as changes in the physical environment. "Ecosystem", as a functional unit of all organisms interacting with each other and the physical environment in a given area, provides a conceptual tool for exploring these changes (Simmons, 1996), but consciousness and social structures that facilitate the reproduction of social and natural structures should be included in the ecosystem concept as well (Merchant, 1987).

There has also been some discussion of stages *within* modes of production, more implicit than explicit, in historical studies of the environment in the modern era. While some studies portray environmental changes as broad historic changes not specifically tied to any mode of production

[1] The rationale for this rather antique word is that breakthroughs in computers, robotics, communications, material science, genetics, complexity, etc. were made possible by breakthroughs in electronics. (Davis and Stack, 1992).

[2] This usage is consistent with the usage in Robinson (2004) and Liodakis (2005). The use of the term "globalization" to refer to this new and current stage of capitalism is not meant to imply that only in this stage has capitalism discovered the world market -- capitalism has always been as global as technology allowed it. Nor is this usage meant to surrender the hope of world solidarity or world justice, or to signal a retreat to purely national struggles (if such a thing even exists today). The term "globalization" can be appropriated to describe this period in the same way that Lenin appropriated "imperialism" to describe his period.

(McNeill, 2000; Hughes, 2001; Crosby, 2004), some important studies describe environmental transformations within the capitalist period (e.g., Cronon, 1983, 1991; Merchant, 1989; Foster, 1999). These latter works can be read in terms of stages of capitalism with corresponding ecosystems.[3] The more clearly distinguished the corresponding technological regimes (where technology mediates the human-nature relationship), the more marked is the ecosystem change, and the more visible the ecological revolution. Since the new technologies (including electronics, computers, bioengineering, etc.) that comprise the foundation of globalization-as-a-stage represent qualitatively new forces of production (Davis, 1998; Davis 2000), the ecological revolution of globalization should be visible and identifiable.

Human beings transform the environment in the production and reproduction of their lives, through their economic life. At the boundary of each stage, the transformation of the ecosystem takes place. There are a number of entry points for investigating the specifics of the formation of new ecosystems as a result of economic changes. These include (but are not limited to) technology, transportation and communication systems, production relations, forms of property, market organization, and capital structures. Although any of these categories could be used, capital structures provide a particularly fruitful starting point. When Hilferding described finance capital as the holy spirit of the economy (in Braudel, 1979); he captured the way it permeates every interaction of the economy.

Forms of capital and the human-nature relationship

Capital, as Marx explained, is a social relationship. It describes a way that people are organized in the process of production. The social means of production are owned privately, through control of the production process one class accumulates the surplus labor of another class, this accumulated "dead labor" expands the power and wealth of the owning class, allowing it to exert even more control over the production process, and to appropriate more surplus labor. While capital is ultimately a social relationship, this relationship is expressed in forms this dead labor takes: money capital, productive capital, industrial capital, merchant capital, and so on, depending on the role that it plays in the overall economy. As signifiers of capital-as-social-relationship, the forms of capital also signify aspects of the human-nature relationship (where "the economy" describes the overall interaction of human and nature in the production and reproduction processes). Capital structures imply a relationship to the world.

Property relations describe a particular relationship to "things". Whether these things are held in common, shared, or bought and sold, or bought and sold on credit, or bought and sold, not the things themselves, but as abstract pieces or shares, or not the shares, but the movement in price of the shares, and so on -- these qualities or degrees of relationship are mediated by social relations, and in the case of private ownership, by capital structures. A worker, a family, even an

[3] Merchant describes three ecosystems: indigenous, hunting-gathering with small scale agriculture; the colonial period from 1620 to about the late 1700s, followed by the capitalist period. In *Nature's Metropolis*, Cronon traces changes in the ecosystem of the Midwest through the mid-19th century. Foster's survey *The Vulnerable Planet* discusses environmental history in the capitalist era in several periods: pre-industrial revolution, industrial revolution, imperialism, and contemporary times. While it is fair to question if the pre-industrial production relations in the U.S can properly be called "capitalist" (see, e.g., Harvey, 2001; also Merchant does *not* describe colonial New England as capitalist, and Cronon (1981), in his examination of the same period in New England explores this question), the economy was tied to the world capitalist economy through trade. This connection exerted its own dynamic on frontier life, by binding it to a broader cash economy. If these frontier economies were not technically capitalist, they weren't independent of capitalism either, and were in the process of being absorbed into the growing capitalist world system.

enterprise interacts with and is integrated into the economy through capital forms which in turn will affect production or laboring, and through that the environment. Alienation to the economy (and the environment) is shaped by these capital forms.

For example, a mortgage, which presumes a relatively developed financial system, allows a worker to acquire a home with "just" the down payment, but also requires the ongoing acquisition of cash to pay principle and interest; binding the worker into cash economy, i.e. commodity exchange. That mortgage can then be pooled with mortgages of other homeowner, and sold in the financial markets, attracting more capital for lending, reducing the cost of money (interest). This securitization allows mortgages to be extended to more borrowers, which feeds a housing boom (and allows more risk in economy).

Grain futures provide another example. They function in a similar way to credit, allowing an expansion of economy. But as Cronon (1991) points out, the grain futures requires at the same time an anonymization of nature, where the individual wheat plant tended by the individual farmer disappears as individual and is merged with the grain from other farms into carloads of a class of wheat. The capital structures facilitate a different degree of alienation from agriculture and nature. Cronon's analysis shows how this change is reflection of necessary changes in the production/transportation process if the economy is to take advantage of what rail technology makes possible.

Speculative capital

Forms of capital may be non-existent, or be constrained or play a minor role in one stage but play a dominant role in other stages. They appear or disappear depending on the development of productive forces and productive relations. One such form is speculative capital. Speculative capital, as a subset of finance capital, is capital involved in the trading of financial instruments (Saber, 1999), but has its roots and rationale in risk management. The main forms of speculation go back at least to the 17th century (Chancellor, 1999), but speculation only comes to the fore with transnational production (creating the need), the existence of global data networks (providing the opportunity), and the agents to promote it (Davis, 2005).

Modern speculation emerged with the demise of the Bretton Woods agreement in the early 1970s and the coincident construction of digital electronic communication networks. The abandonment of the gold standard and the resulting currency fluctuations threw a new element of uncertainty into multinational production processes. To provide a degree of stability for the accumulation process, hedging (the offloading of risk) on a new scale became necessary. The Chicago money markets that appeared in 1972 provided one vehicle. These markets also provided a means of putting otherwise idle capital to work in speculation. Speculation is the counterpart to hedging in the sense that it is the taking on of risk for a consideration. The hedger sells risk; the speculator buys it. Through this function the hedger gains stability and certainty; the speculator attempts to accumulate capital through the trade of financial instruments (that is, to re-distribute surplus value to him or herself).

Computer technology has provided the ability to construct and manage complex financial

derivatives. A financial institution might bundle together real estate properties or credit card debt, and re-sell pieces of the bundle as shares to investors. This "securitization" effectively, if invisibly, links the land and buildings or the credit card debtors together with the world of anonymous investors. Like other forms of modern speculation, securitization of things like mortgages, which began in the late 1970s, and credit card debt would not be possible without computers, since complex econometric models are required to price securitized debt (Gorvett, 1999).[4]

Even more sophisticated instruments bundle together multiple derivatives, thereby linking markets in different commodities. The idea is to distribute risk and provide a kind of financial insurance in a volatile global economy. The fate of any one underlying unit -- a property, a mortgage, a credit card holder -- is averaged in with all of the others in the portfolio, aggregating and smoothing out fluctuation. In this way, the global/electronic system of speculative capital allows the local to be sacrificed to the global -- individual failures are irrelevant if the risk is distributed across a broad enough population. Besides the more visible interconnections of organisms in the ecosystem, or economic actors in production and trade, another layer of interactions encompassing both the ecosystem and the economy connects them in abstract ways through the financial system. Speculative capital abstracts the physical interactions into contractual symbols, renders them digitally into near-instantaneous co-existence, annihilating not just space, but time as well.

While Dutch and English financiers pioneered the basic instruments of shares and futures contracts in the 17th century, modern speculative capital is specific to globalization. It can only exist in the presence of a highly developed, densely interconnected global economy functioning across multiple jurisdictions and ecosystems, with substantial pools of available capital, and the

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[4] The April 14, 2006 *Wall Street Journal* reported more evidence of the connection between speculative capital and electronics. An article titled "Supercomputers Speed Up Game" by Edward Taylor, Aaron Lucchetti and Alistair Macdonald reported on how faster computers are contributing the swelling of automated stock trades and consolidation among the world's stock exchanges.

The march of technology -- faster, smaller, cheaper -- continually changes the financial game. The trend allows smaller players into the game:

> Buyers and sellers have been matching up electronically since the 1980s. But an increase in computer capacity readily available to even small hedge funds -- investment pools for institutional investors and wealthy individuals -- has changed the game. "With four people and 50 computers that have the power roughly equivalent to a Cray supercomputer, we can achieve what someone else would need one trader and 100 analysts to accomplish," says Jonathan Kinlay, chief executive of Proteom Capital Management Ltd., a Bermuda-based hedge fund with about $100 million under management.

Nasser Saber, in his excellent and unique book *Speculative Capital* (1999) described how speculative capital tends to more and faster trades to take advantage of increasingly smaller price differences in different markets or (what amounts to the same thing) different derivative configurations, the practice called arbitrage. Proteom, mentioned above, exploits differences in the S&P 500 Index and the individual stocks that make up the index:

> Proteom uses computers to execute complex trading strategies based mainly on stocks in the Standard & Poor's 500-stock index and their tendency to rise or fall sharply and quickly, a measure known as volatility.

Testifying as the importance in electronics in this practice:

> "This business could not have existed 10 years ago [because] the computational power was not available," Mr. Kinlay adds. "The execution of a trade, the analysis of the live data, the updating of databases and the construction of portfolios of stocks are all automated."

The technology has also reduced trading transaction costs, make more trades financially feasible. The article cites the growth in transaction volume at many exchanges, as well as the growth in the share prices of the exchanges themselves.

Of course, one good turn deserves another, driving the process forward: "'There is an arms race [among exchanges] to be the fastest,' says Steve Swanson, president of brokerage firm Automated Trading Desk LLC."

electronic infrastructure through which to circulate. That is, without the need for large-scale risk management, speculative capital remains an important but marginal aspect of the broader field of finance capital. Without otherwise idle pools of capital, there is nothing to speculate with. And without an electronic infrastructure, the connection and transaction costs make the widespread use of speculation prohibitively expensive.

Speculative capital contributes to *abstraction*, *diffusion* and *generalization*. Speculative capital leads to abstraction because it is not directly involved with the production process (that is, in the production of use values) but is at least two orders[5] removed from direct interaction with the environment in the production of commodities. The *derivative*, the fundamental instrument of speculative capital (Saber, 1999), is derived from, or abstracted from an underlying phenomenon.

Speculative capital enhances diffusion via the derivative, which allows the pooling of multiple underlying contracts (the representations of material interactions) into one instrument, and the conversion of instruments to a highly mobile, liquid form (in the sense that it can flow easily between markets and actors). Once diffused, speculative capital facilitates the generalization or universalization or unification of markets, production, energy and financial flows, towards the formation of a general rate of profit.

The disruption of the social contract and the individuation of social security (or the shredding of the social safety net) directly flow from globalization, with its mobile capital and merged labor markets. The atomization of processes that accompany globalization and digital production contributes to the atomization of communities, or put another way, to the separating from the local and merging into a global process without a sense of identity or community. Part of this disconnection is the separation of effort and reward. With speculative capital, the accumulation of capital bears no apparent or direct relation to the process of human beings producing values (in much the same way as robotic production disconnects the production of use values from human labor). The disconnection at the production process is matched by a reconnection to the economy via debt. Wage slavery and debt slavery become indistinguishable. The commodification of family and social relations passes through credit card nexus. And this consumption-fed debt is absorbed into speculative capital through the securitization of debt.

Speculative capital has become the dominant form of capital, the form of capital that exerts a controlling role in the economy. Through money and bond markets, speculative capital can exert powerful pressure on local economy by affecting exchange rates and government ability to borrow; which in turn affects the cost of imports, in particular oil. Because hedge funds are so highly leveraged, their impact far exceeds the amounts investors have deposited. The leveraged capital in hedge funds has also played an active role in individual enterprises.[6]

The general program of neoliberalism is the ideal climate for speculative capital: the ability of capital to move in and out of economies easily; transparency in accounting; low inflation (cheap money for leveraging); privatization (investment opportunities); no state interference. Volatility

[5] First order is a loan or floated stock to raise money for production. Second order (or secondary) markets are stock markets or bond markets where shares or loans are bought and sold. Third order (or "tertiary markets") is speculation on the rise or fall of groups of shares via trading on stock market indexes. A fourth order, or "quaternary market" would be derivatives based on many indexes, or "options on options." (Bass, 1999)
[6] See, e.g., Diya Gullapalli, "How U.S. Firms Are Pulled To the Mat by Hedge Funds", *Wall Street Journal*, February 11, 2006, B1. "Hedge funds, on the hunt for better returns amid slumping performance, are increasingly investing in companies with the goal of forcing strategic changes to pump up the stock price."

provides hedging demand and arbitrage[7] opportunities. Through speculation, the global economy is linked together and also dispersed. Technology (the means of transportation and communication) allows capital to become more far-flung. Marx understood this general process, which culminates in globalization:

> Capital withdraws from a sphere with a low rate of profit and wends its way to others that yield higher profit. This constant migration, the distribution of capital between the different spheres according to where the profit rate is rising and where it is falling, is what produces a relationship between supply and demand such that the average profit is the same in the various different spheres... Capital arrives at this equalization to a greater or lesser extent, according to how advanced capitalist development is in a given national society ... This constant equalization of ever-renewed inequalities is accomplished more quickly, (1) the more mobile capital is, i.e. the more easily it can be transferred from one sphere and one place to others; (2) the more rapidly labour-power can be moved from one sphere to another and from one local point of production to another. (Marx, Capital, Vol III, p. 297-8)

Speculative capital, as the most mobile form of capital, completes this process.

Globalization and the environment

Robinson (2004) notes that "Most social scientists agree that globalization is a multi-dimensional process involving complex changes at many different levels, including economic, political, and cultural levels." (p. 9 - 10) To this list one can also add the environment.

Each stage or period (and, as marker for each stage, technology regimes: manual, industrial, electronic) alters most, if not all, dimensions of production: extraction (including the speed and the amount of labor and the types of labor required); management of resources; use maximization of the resources (e.g., utilizing what was formally waste); access to resources that under previous regimes would be inaccessible; creation of new versions of products (e.g., hybridized species in past periods; engineered species or synthetic materials today); processing, preservation, storage, transportation and marketing (including the labor and coordination); and the circulation of credit and money behind the whole process. At each stage, the particular production process has many particular interactions with the environment; and the ecosystem is changed in particular ways *specific to that production regime*.

Globalization is no exception. Each feature of globalization has environmental implications. In his concise *Environmental History,* Simmons (1993) describes the human impact on the environment throughout history in terms of two broad trends: spatial extension of human activity and intensification of human activity. This dovetails with two characteristics of globalization that Robinson notes: the completion of geographic extension of capitalism as a system, with the intensification of production being the sole means of expansion.

The geographic *extension* of capitalism means that every biome and ecosystem is pulled into

[7] Per Saber (1999), "arbitrage" is the technique of buying something in one market, and simultaneously selling it on another market to exploit price differences on the two markets with the intent of making money. While it appears similar to arbitrage, "hedging" takes place over time, and has as a defensive goal, the preservation of equity. See pp. 69-71, 109.

capitalist relations as a use value in the production of exchange values.[8] These uses might be as source of raw materials, for cultivation, real estate development, or recreation. Even if an area is not formally integrated into production, one cannot visit such an area and be outside of capitalism. Wild areas do not present a frontier of new possibilities, only reserves or "other" that emphasizes the totality of capitalist extension. There is no "wilderness" today that exists outside of capitalism.

The *intensification* of production takes place in many ways. For example, although forestry, fishing and mining are ancient production processes, today they take place within the context of globalization and its electronic-driven production. The maximization of profit is achieved by totalizing the consumption of natural resources as quickly and thoroughly as possible using modern technology: clear-cutting; mountaintop removal; electronic-aided factory fishing. Production is also intensified as more areas are pulled into the commodity relationship. Commodification includes the transformation of once personal activity, for example, various aspects of domestic life, into a commodity. It also includes the transformation of public spaces and activity into private spaces and fee-based services. Commodification, however, does not just extend to every aspect of social life, but to every aspect of biological life as well through gene patents.

The increase in industrial and other activity that release greenhouse gases (GHGs) is another aspect of intensification. In this way, climate change is a dimension of globalization. Although climate change is tied to fossil fuel consumption to power the industrial economy, the general process of pulling all regions of the globe into capitalist relations, including the dispersion and expansion of production, the intensification of consumption, the extension of credit, etc. have driven a sharp upswing in the volume of carbon dioxide being dumped in the atmosphere. While greenhouse gases are not unique to globalization, the concentration and rate of dumping is. Although globalization arises on the basis of electronics, overall development is uneven and progresses in stages. Industrial production obviously continues, using whatever techniques make profit-sense. What is different with industrial production under globalization is (a) how it is integrated into the global economy (b) the broader range of labor versus technology options (c) coordinating technology (d) changes in other aspects of the economy that it depends on (e.g., transportation and finance). New technologies adjust energy consumption patterns. On the one hand, electronics requires more electricity, most of which is generated by CO2 producing power plants. On the other hand, new technologies hold out the promise of greater energy efficiency. Whereas industrial production under globalization tends to be more efficient in the use of energy[9], there is still a rise in emissions due to the overall increase in economic activity.

Speculative capital

Globalization influences the environment through speculative capital at a variety of levels. A

[8] If not in current use, the resource is held in reserve as potentiality, in any case it appears on a balance sheet or in strategic projections.

[9] Worldwide, as well as in the U.S., energy consumption per dollar of GDP has dropped over the past few decades, and CO2 emissions per GDP dollar have also fallen over the past 20 years. These statistics reflect changes in technology and the kinds of economic activity being done. In the U.S., from 19.57 British Thermal Units (BTUs) in 1949 to 9.20 BTUs in 2003 (U.S. Department of Energy, 2005). Worldwide, from 284.8 metric tons oil equivalent per million $international to 239.4 in 2001 (World Resource Institute, EarthTrends environmental information, downloaded May 9, 2006 from http://earthtrends.wri.org/searchable_db/index.php?step=countries&ccID%5B%5D=0&theme=6&variable_ID=668&action=select_years)

1999 World Resources Institute (WRI) roundtable on the global financial system and the environment, held in the wake of the Asian, Russian and Brazilian financial shocks in the final years of the last century identified several general areas of concern. As speculative capital comes to play a controlling role in the economy, countries tend to tailor economic policies to speculative capital. The "structural adjustment programs" mandated by the International Monetary Fund as a condition for development aid are one well-discussed example. The general neoliberal agenda of minimal state intervention and regulation works against environmental oversight. Since speculative capital tends to work on short time horizons, speculative capital response to local policy is expressed in the bond and money markets, Wriston's "instant plebiscite." (Bass, 1996) Once the structural adjustment programs open the financial system, the ongoing supervision of the economy becomes diffused through the financial markets. The flow of speculative capital in and out of national economies, "hot money", can have a destabilizing effect on economies. The WRI report identified four main environmental impacts: (1) rapid depletion of natural resources as a way of coping with financial crises; (2) short investment horizons that mitigate against long-term environmental stewardship; (3) lax environmental regulation to lure foreign capital; and (4) economic instability that may undermine local environmental programs and institutions.

Besides these general environmental effects expressed through the speculative financial system, speculative capital also influences the environment in particular ways through specific financial devices. Nature appears in two fundamental ways in the economy: as resource (either as tap or sink), and as source of risk. These two aspects are not unrelated. For example, the use of the atmosphere as a disposal sink for waste gases contributes to a build-up of heat in the atmosphere, which increases the intensity of tropical storms, resulting in increased weather risk. (Rahmstorf et. al., 2005) As part of the intensification of capitalism, new financial structures move into both of these areas of nature. These new structures provide several functions. In the classic rationale of speculation, weather derivatives, for example, provide a risk management service, adding some stability to production and circulation. They are a source of revenue for the speculative sector of capital via trading and management fees, as well as arbitrage opportunities for firms' trading desks. In the case of timber real estate investment trusts, they provide a means of accessing additional, larger, pools of capital for the exploitation of natural resources. New instruments like weather derivatives also provide a way of monetizing previously un-monetized aspects of nature (e.g., temperature), and in the case of emissions, a (problematic) social accounting function. The market, as a kind of information processing machine, provides information of economic processes; financial structures like the modern re-insurance industry, act as economic sensors, synthesizing and communicating a collective perception of the state of the economy.[10] New structures indicate the ways in which speculative structures affects the non-human environment.

Example 1: Timber real estate investment trusts

Timber real estate investment trusts (REITs), for example, are a new financial instrument to securitize tap resources of timber and land. Historically, timber companies have been vertically

[10] As the classic tool for weather risk management, the insurance industry provides one indicator of how the financial system is responding to climate change. As Evan Mills (2005) notes, "the insurance sector is a lightning rod, serving as global integrator of impacts across all sectors of the economy, and messenger of these impacts through the terms and price signals it projects to customers."

integrated enterprises, with the same company owning the land, cutting and milling the trees, and marketing and selling the lumber. As with other industries, globalization has had a profound impact on the forest industry. Since the 1990s, the timber industry has undergone a profound reorganization as moves into a global economy. Markets for forest products have become more integrated as a result of growing exports (facilitated by decreased transportation costs) and cross border mergers, acquisitions and investment (where decreased coordination costs come into play). But a profound change has also taken place in forest ownership. A general trend away from diversified companies to more tightly-focused companies, and pressures from financial markets to "unlock shareholder value" by spinning off parts of vertically integrated companies that are undervalued, has resulted in a dramatic shift of forest land ownership away from industry owners engaged in the production of timber products, to different classes of investors, especially in the United States (Sande, 2002). Timber companies tend to see forests narrowly, as a source of wood, but as one report noted, "there is a burgeoning plethora of [timber] values that might be monetized" (Hagan, Irland and Whitman, 2005), including carbon credits, conservation, and real estate development.

These investor classes take the form of "timber investment management organizations" (TIMOs) which manage forest lands on behalf of institutional investors, like pension and endowment funds, "master limited partnerships" which manage funds for wealthy private individuals, and a new structure, timber REITs. Institutional investment in timber via TIMOs in the U.S. grew from $150 million a year in the 1985 - 1989 period to $1 billion a year in the 1995 - 1999 period. Internationally, the numbers grew from some $100 million/year to about $900 million/year for the same time periods. A November, 2005 *Wall Street Journal* article reported that Harvard University had $2.6 billion of its endowment invested in timber, and was the second largest forest owner in New Zealand (Browning, 2005). Timber REITS are real estate investment trusts that invest exclusively in timber lands. Functioning like mutual funds for timber lands, they allow many "smaller" investors to own pieces of many parcels. Timber REITs are relatively new, the first private timber REIT was formed in 1998; the first public timber REIT formed a year later. The ownership numbers for REITs are also dramatic: the same *Wall Street Journal* article reported that in one sale, a Boston money-management firm bought more than 5% of the state of Maine.

There are a number of environmental implications of this transformation of ownership. Erickson and Rinehart (2005) see TIMOs as good conservation partners, because they have no debt, invest for the long haul, and are concerned with timber value. REITS, on the other hand, are concerned with servicing debt and maintaining REIT share prices, so tend to do whatever is necessary to meet goals, which has included destructive overharvesting and parcelization, where large tracts of land that form a contiguous ecosystem are sold off in smaller parcels. The parcels end up distributed among many owners. Fences and other barriers might interrupt the ecosystem. Parcelization is also seen as a threat because it divides management up across many owners who may have inconsistent conservation practices or development goals, ultimately harming biodiversity. Also REITs are not concerned with timber value per se, but with what is referred to as "higher better use" or HBU, i.e. whatever use yields the highest return. HBU may mean timber, or it may mean real estate development. Hagan, Irland and Whitman (2005) suggest that it is difficult to make broad generalizations about institutional investors, but do see greater land turnover and parcelization, as well as weakened support for forest research or sustainable forest

practices. According to Block and Sample, TIMOs (in particular, the pension funds), have a fiduciary obligation to maximize returns, but because of their public face, may be more sensitive to conservation issues.

Example #2: Insurance and weather derivatives

Production takes place across time, exposed to uncertainty and risk. Insurance has been the traditional financial structure for managing risk; and traditionally, non-human nature has been a major source of risk. And of those natural possibilities, weather -- drought, flood, hurricane, heat, cold, wind -- comprises a significant part.[11] Insurance has also been put forward as a broader means of addressing social uncertainty (Shiller, 2001).[12] Although insurance deals with uncertainty, the universe of uncertainty needs to be well-defined in order for insurance to acquire a price. Odd cases like getting insured against alien abduction notwithstanding, actuarial tables and historical weather patterns provide a basis for estimating risk and setting premiums. While catastrophe insurance -- insuring for major events like earthquakes and hurricanes -- present major challenges for the insurance industry, an even bigger problem is the change in historical weather patterns.

The insurance industry is the largest industry with annual revenues of $3.2 trillion,which would make it the third largest economy if it was a country to itself (Mills, 2005). Almost every segment of the insurance industry has some exposure to likely impacts of climate change, whether it be through more severe storm damage (see, e.g., Rahmstorf et. al., 2005), or higher mortality rates due to higher temperatures (as was the case with the European heat wave in 2003), property damage due to rising water levels or melting tundra, losses (data, food, etc.) from power surges or outages, or relatively minor damage from car accidents as a result of ice storms. The industry faces specific "technical risks" as the pattern and nature of "loss events" changes: they happen closer together, in different and more places, have many consequences, with damages that vary exponentially with weather intensity. Because premium pricing and business models are based on the past, changes in weather patterns also expose the insurance industry to "market risk" from an inability to properly price the risk or settle claims in a timely way (Mills, 2005). Globalization presses on the insurance industry in similar ways to other industries via increased competition and consolidation; globalization also adds climate change to the list of challenges. [13]

The insurance industry provides a roundabout way for the externalities of capitalist production -- e.g., pollution and climate change -- to be generalized, acquire a price, and be distributed back into production (and to workers and consumers) as an internality in the form of higher risk

[11] Estimates of the weather impact on the economy vary. Some estimates suggest that 1/4 of the gross domestic product is weather or climate sensitive (http://www.magazine.noaa.gov/stories/mag24.htm), meaning about $3 trillion is affected by weather. However, when overall climate change is factored in, this number could range much higher.

[12] In March, 2006, the U.N.'s World Food Program (WFP) purchased weather insurance from French insurer AXA Re for some $900,000, to provide cover in case of drought in Ethiopia this year. AXA will provide the WFP with $7.1m in contingency funding if the rainfall between March and October falls significantly below average. For an insightful analysis on this deal, see this blog: http://www.felixsalmon.com/000426.html

[13] Climate change will affect the economy in many small events punctuated by catastrophes. While the small events in the aggregate result in more losses than the large (i.e., catastrophic) events, catastrophic events pose special challenges for the insurance industry. It is difficult for insurers to amass the kind of reserves necessary to handle catastrophic losses, in part because such large pools of cash make the insurance companies attractive takeover targets (Gollier, 2005). The free-for-all of the global financial system interferes with its own immune system. Given the possible impact of climate change, the insurance market may be unable to absorb the risk.

premiums. As this process of internalization takes place enterprise behavior may change. Historically, insurance companies have played an important proactive role in risk management, by promoting reforms like building codes and fire prevention (as well as underwriting the cost of the first fire brigades). Conceivably this historic role could be extended to steps to cut greenhouse gas emissions, or to protect wetlands and other natural features that might mitigate the impact of severe weather.

The digital infrastructure of globalization has allowed new forms of risk management. Devices like insurance securitization, catastrophe bonds and weather derivatives provide other ways of meeting the insurance function. While the securitization of home mortgages began in the late 1970s, insurance securitization did not appear until the 1990s, and has met with limited success. While home mortgages and credit card debt provide relatively stable income streams, by its very nature insurance is unpredictable. While their goal was to transfer risk from insurance companies to the broader financial markets, the insurance securitization and catastrophe bond markets have remained small and private.

Weather derivatives have a broader appeal, and have had more success. In a weather derivative, contracts are bought or sold based on "degree days". Will the temperature exceed or below the average temperature? These instruments can be used to hedge against unfavorable temperatures (Dampier, 2005). A natural gas company, for example, may want to protect against the risk of a warm winter; a soft drink manufacturer against a cool summer. To the extent that higher temperatures are associated with natural disasters (e.g., lightning-related insurance loses increase with temperature (Mills, 2005)), weather derivatives provide a means of offsetting climate change risk.

Insurance and weather derivatives provide a way of quantifying the present and future cost of climate change. By providing the vehicle for internalizing and distributing climate change costs, they may have an impact on climate change related decisions. They also reveal additional layers of relationship between the environment and the economy; even a way that the seemingly intangible aspects of the environment, like air or water temperature becomes abstracted and symbolized by financial contracts, in the same way that abstract wheat of a particular grade was symbolized into grain futures in the mid-19th century.

Example#3: Carbon financial instruments

Emissions markets are probably the best known experiments in environmental financial speculation. Emissions trading involves the creation of a fixed number of pollution credits or "rights", typically by a governmental body, and the formation of a market to trade these rights. The government body sets a desired pollution target level for a particular pollutant (the "cap"), e.g., sulfur dioxide (SO_2) or carbon dioxide (CO_2), creates permits (or "allowances") to generate the target pollutant, and allocates the allowances to polluters. In theory, an enterprise cannot emit the pollutant without a corresponding "permit" to do so, and faces fines (e.g., in Europe, currently 40 euros/metric ton for CO_2) if emissions exceed permits. Enterprises that reduce emissions may sell their unused permits to an enterprise that would rather purchase permits than reduce emissions. The emissions trading markets enable pollution to acquire a price. Or looked at

from a different point of view, the government body has created a title to the use of the air, thereby commodifying, and privatizing, the atmosphere.

Of the wide range of possible strategies for curbing GHGs, the Clinton administration pushed through emissions trading as the device of choice (Lohmann, 2005). From the point-of-view of speculative capital, this represents the perfect choice. It requires new trading markets to be established, and traders to facilitate the exchange of permits, and creates new opportunities for arbitrage, hedging and derivatives. Speculative capital is not just the capital sloshing around, but also the agents that promote and represent it, including trading firms, exchanges, accounting firms and consultants. These agents helped promote emissions trading as the climate change solution. E.g., Enron was an important corporate promoter of Kyoto, and while it stood to gain as a natural gas pipeline company (because natural gas releases fewer GHGs than coal), it also was transforming itself in the 1990s into a major trading firm in electricity and other commodities (Warner, 2002) that would benefit from the trading opportunities in GHGs. A small industry has developed to facilitate the trading of emissions, including the exchanges where the emissions are traded. With the beginning of implementation of Kyoto in 2005, a number of start-up exchanges competed in Europe, where emissions reductions are mandatory, to become the main site of emissions trading. Two main markets, the European Climate Exchange (ECX, owned by the Chicago Climate Exchange), and the French PowerNext have emerged as the main markets for "carbon financial instruments" or CFIs. The Chicago Climate Exchange (CCX) provides a trading system for U.S.-based carbon emissions.[14]

Although the Bush administration subsequently refused to sign the agreement, the Kyoto Protocol provisions are moving forward in the 163 signatory countries. The Kyoto Protocol calls for industrialized countries to achieve an average 5.2% reduction from 1990 levels in six GHGs by 2012. Following Russia's ratification in late 2004, the terms of the protocol went into effect for the treaty's signers in early 2005. Countries are allocated a number of permits based on 1990 levels minus the agreed reduction. Countries then grant the permits to polluting industries, grandfathering existing pollution, so the biggest polluters get the most credits. (Bachram, 2004)

The Kyoto protocol adds a novel provision to emissions market in the form of "offsets". By investing in pollution reduction efforts, a company can create offset credits that may be sold, or used to make up a permit shortfall. Under the "Clean Development Mechanism" (CDM) provision of Kyoto, these reduction projects are undertaken in countries that have no reduction targets, mostly developing countries. For example, by investing in a tree plantation in Uganda or Brazil, a company can gain pollution credits that allow them to avoid reductions in pollution at home. Companies can also invest in alternative energy production, or improve existing facilities, and create credits for the pollution that would have been created in what Bachram (2004) calls the "alternative future" and Lohman (2005) "counterfactuals".

The Kyoto Protocol has been controversial. The Bush administration refusal to sign-on to Kyoto, ostensibly because of its economic impact, is caught up in a broader web of unilateral

[14] Since the U.S. does not participate in Kyoto, membership is voluntary, but reduction agreements of members are legally binding. There are various reasons why the 40-plus U.S. corporations, local and state governments and universities would sign-on: the public relations benefit, a sense of organizational responsibility, or to be ahead of the curve in the event that the U.S. does adopt a Kyoto=type scheme. The U.S. market, because membership is voluntary, is relatively thinly traded. There are other U.S. initiatives to curb emissions despite the federal government recalcitrance, including the Regional Greenhouse Gas Initiative of seven northeastern states. (CCX website, news reports)

international policy on the one hand, and demonizing science and liberalism as a rallying point for his conservative base on the other (Armitage, 2005). By drawing a battle line at the Kyoto agreement, the Kyoto agreement and provisions have become a proxy for concern about global warming. Opposition to Kyoto has become equated to opposition to abating climate change. For supporters of Kyoto, the protocol is better than nothing, or a starting point, or precedent for further global efforts to solve a global problem.

But the Kyoto agreement has faced opposition within the environmental movement as well. One criticism is that it does too little, too late. The IPCC report has said that GHG reductions of 50 - 70 percent are needed to stem global warming, and Kyoto only calls for 5 percent. Besides not doing enough, the focus on emission permits pushes forward the general project of privatization, commodification, and total ownership. Charges of "carbon colonialism" have also been leveled at Kyoto's provisions for offset projects in developing countries (Bachram, 2004). Besides the political controversy over whether it is enough or too much, and the property and power relations implied in Kyoto's provisions, the protocol also has a number of technical problems, as Lohmann (2005) brilliantly enumerates. For any market to work, the commodity being traded needs to be clearly defined. While defining emissions and baselines and reduction targets is difficult enough[15], the problem of defining the actual benefits of carbon sinks (e.g., a tree plantation) is scientifically complex[16], and once social dimensions are factored in (e.g., what impact does displacing people from the tree plantation site, and, say forcing them into a city have on CO2), impossible. The case of "alternative futures" and "counterfactuals" is equally problematic. The determination of credits is subjective; and assumes that a company would not have made the changes anyway, freezing any activity to a point in the past. The determination is left to an army of consulting bodies, with a significant risk of fraud. Enforcement is another problem -- are companies accurately reporting emissions, or being monitored properly? In many ways, the entire Kyoto system is based on a set of agreed upon fictions written by accounting firms, the governing bodies and industry. It is unclear if the Kyoto provisions will have any noticeable effect on global warming; and worse, gives the illusion of progress.

As a form of capital itself, CFIs represent new kinds of ties between north and south, and east and west. By converting GHGs into financial contracts, the emissions trading markets (e.g., the Chicago Climate Exchange) provide a way to re-distribute pollution, in much the same way that the financial system generalizes the distribution of surplus value. On May 4, 2006, the CCX announced that it had facilitated the first trade between the European and U.S. trading systems. Baxter Healthcare transferred 100 metric tons of European carbon allowances that were not needed by an Irish manufacturing unit to a U.S. unit. The transfer took place in two steps: the allowances (or permits to pollute) were transferred to a CCX account, and cancelled in Europe. New, equivalent U.S. credits were created and transferred to the Baxter CCX North American

[15] Following the collapse of the CFI market in the April, 2006, there were charges that countries overestimated output to minimize the impact on domestic industry; or that companies overestimated output to minimize their efforts, or to garner unneeded permits which they could then sell. For a variety of links to news reports and background items on what Grist called the "EU carbon-trading hullabaloo" see http://networksdialectics.blogspot.com/2006/05/more-on-emissions-markets.html

[16] There has been considerable study of the costs (van Kooten, Eagle, Manley, and Smolak, 2004), carbon sequestering efficacy. Science generally holds that mature forests go into carbon stasis (Flannery, 2005), as they release as much CO2 through respiration and decay as they sequester. The implication is that young forests are ideal for carbon sequestration, hence the tree plantations. But recent studies challenge this, arguing that old growth forests continue to function as sinks (e.g., Knohl, Schulze, Kolle, Buchmann, 2003; U et al, 2004; Li, 2005). Other studies suggest that peak sequestration happens in medium age forests (Pregitzer, 2004). Even the activity of trees in general, regardless of age, is still surprising researchers -- one study discovered that trees generate a significant amount of methane gas, a GHG (Keppler, Hamilton, Brass, and Reickmann, 2006), and other studies indicate that global warming may interfere with trees ability to sequester CO2 (Reich et. al., 2006). The interactions of various organisms and processes in the environment is complex.

account. According to the CCX press release, "through this transfer, Baxter is able to take the extra allowances it has 'earned' through its conservation and emission reduction activities in Ireland, and apply those credits to its efforts in North America." (Chicago Climate Exchange, 2006). That is, through the financial system, pollution in Ireland was effectively transferred to the United States. To the extent that tree plantations and other carbon sinks do sequester CO2, the trading scheme provides a kind of reverse flow of pollution, from the site of the offset sinks back to the north. The traditional process of transferring pollution involved the export of production facilities to developing or periphery countries (Grimes and Kentor, 2003). But as globalization matures, and production is dispersed such that factories are sited to flexibly take advantage of local conditions as necessary, speculative capital provides a new mechanism for transferring and generalizing global pollution in the global ecosystem.

The emissions schemes, as an expression of speculative capital shaping solutions to environmental issues, take concrete form in the standard type of carbon offset project, the tree plantation. Typically these are monocultures of trees like eucalyptus or pine that grow fast, fed by fertilizers and protected by chemicals. The native flora is rejected for silviculture that is easier to manage and quantify for credit calculation. Because the plantations are monocultures, they do not support the diversity of species found in a natural forest. This is perhaps the most explicit expression of an instrument of speculative capital invoking a new ecosystem.

The ecosystem of globalization

There has been little work in extending the concept of "globalization as a epochal shift" to the environment. Environmental history typically deals with past periods, or when it has ventured into today, it has treated the current period not as something new, but just more of the same, except perhaps more so (e.g., Foster, 1999). Within the anti-globalization movement, the environment is generally discussed as the culmination of 200 years of industrialization-driven ecosystem degradation or 500 years of European domination of nature (Reinsborough, 2004), a rendition of the "Edenic narrative" (Merchant, 1995) where there once was a paradise which humans have been busy chopping down and paving over. Global studies treatments like Hughes (2005) provide a survey of environmental issues coincident with globalization, like population, biodiversity, energy and resource constraints, and political control. Others treat environmental issues in the language of imperialism or national oppression (Grimes and Kentor, 2003; Bachram, 2004), i.e. again, that there is nothing new, only more of the same. Still other investigations look at global environmental initiatives as case studies of global governance (Oosthoek and Gills, 2005; Stevis, 2005), but not as ecosystem change. Another category of investigation, and the source of some debate, has been the question of a "second contradiction of capitalism", the contradiction between capitalism and the environment, where despoliation of the environment and exhaustion of resources threatens the accumulation process (O'Connor, 1998; Burkett, 1999).

As important exceptions, O'Connor (1998) touches on changes to the environment in describing what a "sustainable" environment might look like from a "corporate viewpoint" in what he refers to as "global capitalism today". Dyer-Witheford (1999) lists ways the "high-tech capitalism" reworks the circuit of the "(non-) reproduction of nature." The red-green journal *Capital Nature*

Socialism devoted its March, 2005 issue to the neoliberalization of nature where "neoliberal capitalism" is used to describe the current "capitalist era." (Heynen and Robbins, 2005) Though not systematic treatments, in these writings one can see a beginning outline of the "ecosystem of globalization".

What exactly is the ecosystem of globalization? At the risk of being anti-climactic, the ecosystem is simply the environment we have today and our interactions with it. Globalization is a new stage, and the economy always interacts and shapes the broader environment, creating specific ecosystems to enhance and further production relations. The transition to this new ecosystem is as abrupt as the transition to globalization, that is, it emerges in stages, over time and space. But eventually, the changes are well-established enough that the new ecosystem can be named and identified.

Features of this ecosystem include an atmosphere with significantly higher levels of CO2, probably leading to an overall warmer air and sea temperatures, smaller icecaps, higher sea levels, more violent storms, and regional climate changes (IPCC, 2001). The ecosystem has significantly fewer unique habitats, with a corresponding loss of species on the scale only matched two or three times in earth's history. Through the mobility of commodities and people, a handful of species, including bacteria and viruses extend their range, overwhelming local competing species -- a kind of extension paralleling capitalism[17]. This process will be exacerbated by climate change, as finely-tuned ecosystem interactions are upset by earlier springs and later autumns. More environments are directly managed to maximize the accumulation process. This management is facilitated by new engineered species incapable of living in the wild without human intervention. The concept of "wild nature" persists in private parks, reserves and public fee-based areas, and consumable by whoever can afford the membership or entrance fee (Robbins and Luginbuhl, 2005). The majority of human beings live (or will shortly) in the "planet of slums." (Davis, 2004) There are some bright spots. Global cities, eager to attract global corporations, adopt urban forestry and park programs (Longworth, 2004; Heynen and Perkins, 2005). "Green" grows as a commodity, and consumers are gaining more green choice. Mass media provides an important, if not the main way, that those with access to media interact with nature. Those who live in the suburban sprawl of the north are baffled by interactions with wild animals in their backyards that don't behave like those on TV[18].

The examples of speculative instruments, dependent on the technological infrastructure of

[17] The history of exotic species is the history of humankind. They have been as mobile as the productive forces have allowed them, and generally mirroring the power flows of civilization. See e.g., McNeill, 2000; Crosby, 2004. For a recent example of an exotic replacing native species, and the local economy adapting to the new ecosystem, see James Janege, "Carpe diem on the Illinois River", *Chicago Tribune*, May 7, 2006. Brought to the U.S. in the 1960s to eat algae out of catfish ponds (another globalization ecostory), the voracious and prolific fish found its way to the Mississippi and has been making its way north since. "There is no beating the Asian carp, the river men say. So they're trying to make a living off of it, and an Illinois carp fishing industry is beginning to grow up around them" with major customers in ethnic neighborhoods of New York, Los Angeles and "elsewhere" (another globalization story). More recently, there are other news reports of a major carp die-off. "Since Tuesday evening, thousands of dead carp have been seen floating down the river... Biologists say the die-off seems to gave been widespread... So far the fish kill eappears to have affected only Asian carp and a few carpsuckers." A la War of the Worlds, a virus is suspected as the cause. (Associated Press, "Asian carp die off in Illinois River", Belleville News-Democrat, downloaded June 5, 2006 from http://www.belleville.com/mld/belleville/news/politics/14740199.htm.)

[18] See, e.g., James Sterba, "Wild Kingdom: In Orlando, faux nature clashes with the real thing -- as developers and Disney keep blurring the line", *Wall Street Journal*, June 3, 2006, p. A1. "[M]uch modern sprawl is built, unconsciously, to be wildlife-friendly -- what wildlife biologists call 'enhanced habitat,' with more food, shelter, water, hiding places and protection from predators than exist in the wild. People, meanwhile, make sprawl even more inviting, wittingly and unwittingly. They're increasingly ignorant of how wild nature works -- what author Richard Louv calls 'nature-deficit disorder.' Just as they treat pets as children, so to do many treat wild animals as pets, leaving out birdseed and pet food, tossing a cookie to a backyard bear."

globalization, indicate some of the mechanisms of how this new ecosystem is created. Capitalism has always transformed natural processes into values. Speculative capital takes them an extra step, transforming nature into abstract money forms as financial contracts, permits, and shares -- what Marx called "fictitious capital". This process began with the first agricultural futures; Dutch tulip futures which eventually devolved into the famous tulip mania in the early 1600s can be seen as one of the earliest forms. Today these structures have evolved beyond crop futures and mineral production futures to weather, pollution, land, and carbon-fixing capacity. They facilitate the understanding of nature as abstract, symbolic, alien, manageable and artificial. Once transformed into contracts, and the contracts into digital representations that can then be traded electronically, speculative instruments begin to facilitate the formation of a generalized ecosystem along with a general rate of profit.

Red-green environmentalists have wrestled with the question "is capitalism sustainable?" However, as James O'Connor (1998) asked out, "sustainable for whom?" "[C]orporations construct the problem of the environment [as] *how to remake nature in ways that are consistent with sustainable profitability and capital accumulation...* [N]ature is transformed into a specifically capitalist nature... Seen in this way, at some point in the future, nature would become unrecognizable as such, or as most people experience it." (p. 238-9, emphasis in original) The globalization ecosystem may not be pretty, or sustainable without constant human intervention, but it can in some sense be kept going. Capitalism is manufacturing a franken-world ecosystem that sustains accumulation. It works to create the conditions to sustain capitalism, and fails to address the polarization of wealth and the total immiseration of 3/5ths of the world's population.

But since capitalism must expand or die, and the planet has finite resources, what then? One mobile parameter in carrying capacity is technology -- that is, technology changes. James Malin (1948) argued that the concept of "resource exhaustion" was effectively meaningless, because as yet undiscovered technology can bring new resources into the "flow of utilization":

> The earth possessed all known, and yet to be known, resources, but they were available as natural resources only to a culture that was technologically capable of utilizing them. There can be no such thing as the exhaustion of the natural resources of any area of the earth unless positive proof can be adduced that no possible technological 'discovery' can ever bring to the horizon of utilization any remaining property of the area. An attempt to prove such an exhaustion is meaningless, because there is no possibility of implementing such a test. Historical experience points to an indeterminate release to man of such 'new resources' as he becomes technologically capable of their utilization.

New technologies can push biophysical limits upwards. Besides raising the biophysical capacity, new technologies can also shrink human environmental impact. Breakthroughs in electronics, computing, materials and biology have upset previous assumptions about technology and resource consumption. In particular, "knowledge-intensive" technology is potentially cheap, resource conservative and energy efficient (Davis and Stack, 1993, 1996). The technology input has the potential of shrinking, while producing the same or more material throughput. Technology will open new opportunities for capitalism to sustain itself.[19]

Some have argued that the second law of thermodynamics will come into play and force a

[19] Alternative (and sustainable, in the popular sense) technology will also open new opportunities for any alternative economic system, and in new technologies will be necessary in any case to lift up the standard of living for the majority of the world living in poverty.

physical limit on capitalism. Once energy is dispersed it cannot be re-used. Once resources are dispersed, only substantial amounts of energy will allow those resources to be re-assembled into use values. While solar power provides a possible source of such energy, capitalism will not be able to shift to a solar powered economy for political reasons (Schwartzman, 2006).

Still, capitalism is a remarkably flexible and adaptable system. Some corporations are realizing that they must address things like climate change, because they also are on lifeboat Earth, and climate change is an objective, happening thing. They must confront environmental catastrophe if they are to continue as enterprises. Their solution is to make "green" an investment opportunity, to turn it into a site of accumulation, a place to make profits. British Petroleum looks for alternative energy sources because "peak oil" may be a real possibility, and ultimately, it doesn't matter what the source of the energy they package and sell is, as long as they package and sell it. If General Motors can "go yellow" and make cars that run on ethanol, why not? The manufacturers that make smokestack scrubbers for coal plants are a site of profitability, as will be some of the alternative energy companies into which venture capital firms are now pumping money.[20] The Wilderhill Clean Energy Index, which tracks the stock prices of companies involved in the alternative energy business, has almost doubled in price in the past year. Speculative capital finds profit opportunities in carbon emissions trading and weather derivatives.

However, an environmental movement that accommodates itself with globalization may succeed in some narrow way, along some narrow issues to achieve narrow successes. But such a movement will ultimately fail in achieving a world that sustains the people on it in any meaningful way. And the environment also will be the poorer, in the same way that the "Rainforest Cafe" is not a rainforest (or Lincoln Park zoo an African savannah or a tree plantation a jungle, etc. etc.).

The environmental problem for capitalism is similar to the labor-replacing technology problem that electronics poses. For now at least, it looks like capitalism can accommodate these challenges by re-organizing. The "end of value" is not a problem of physics, but a problem of history -- it doesn't end because of labor-replacing technology, it ends because human beings organize and replace the value system with something else (Davis, 2000).

Likewise, capitalism, in the form of globalization, is constructing an ecosystem along the lines that O'Connor described. Capitalism won't dissolve in acid rain or choke to death on carbon dioxide or die of thirst. Framing the current environment as the "ecosystem of globalization" attempts to pull the question of ecosystem change out of a historical narrative, and see the ecosystem that is programmed and rendered by globalization solely in its own terms. The "destruction of the environment" is really the transition from one ecosystem to another, an "ecological revolution". "Destruction" is relative, and implies that some kind of restoration to an older ecosystem is possible, which is highly questionable. One may be aghast at, even terrified by the ecosystem that is emerging, and lament how much is lost. The ecosystem may well be one

[20] See e.g., Jim Carlton and Rebecca Buckman, "Alternative Fuels Attracting Venture Capital", *Wall Street Journal*, B1. " From 1999 through 2004, venture capitalists invested an estimated $4.4 billion in the energy-technology sector, including renewable energy and more-traditional energy projects. That compares with just $380 million in venture-capital money invested in the sector from 1993 through 1998. Energy tech got a further $500 million in venture capital during the first half of 2005, according to Nth Power, a San Francisco venture fund, and Clean Edge, a San Francisco market-research firm."

no longer capable of supporting human life, or at least not on the current scale. Life asserts itself, but the cost may be high. As biologist Tim Flannery (2006) noted, "[N]otwithstanding the destruction of human civilization through the agency of climate change, it's difficult to imagine just how Gaia would 'sort it out.' And even if she does manage to rid herself of us, we would take so many other species with us that the repair job to Earth's biodiversity would take tens of millions of years." (pp 17 - 18)

This only makes the dismal inventory of the emerging ecosystem another starting point for the rejection of globalization, just as other properties of globalization, like the polarization of wealth, or total commodification of social life are starting points. In this sense, the ecosystem of globalization is *political*. Globalization is not a choice within the law system of capitalism (capitalism is compelled to become globalization by its internal dynamics and objective forces). But globalization is a historic choice in the broader sense of how humans organize production and relate to nature. The ecosystem of globalization is part and parcel of overall capitalism in the age of electronics. Transforming the ecosystem of globalization means transforming production relations -- the overthrow of Capital.

Merchant (1989) emphasizes that changes in consciousness are an integral part of ecological revolution. While she optimistically suggests that deep ecology and holistic thinking are examples of the new consciousness accompanying globalization, it probably is more correct to see these not as products of globalization, but as autonomous responses to globalization. The ecological consciousness of globalization is abstraction, commodification, consumption, spectacle: The Nature Company; Animal Planet; eco-tourism; privatized parks; body modifications and zygote banks; the environment as a software problem; carbon financial instruments, timber REITs and weather derivatives. The impulse of environmental movement can be seen as the initiative of the multitude for something else, something better.

Until this relation to nature is understood in its proper, historical context though, the Franken-world is our future. The end of globalization, and the ecosystem that it is creating, is not a process that "nature" will force, or the internal contradictions of capitalism, no matter how many there are. It is ultimately a political act, of political actors struggling and forcing a transformation in the productive relations, and with it the relation of humans to nature.

References

Armitage, K. (December, 2005). The United States and the politics of global warming. *Globalizations*. 2(3) 417-427.

Bachram, H. (December, 2004). Climate fraud and carbon colonialism: The new trade in greenhouse gases. *Capitalism nature socialism*. 15(4).

Bass, T. (October, 1996). The future of money. *Wired* (4.10).

Bass, T. (1999). *The predictors*. New York: Henry Holt and Co.

Binkley, C. (2003). "Timberland: The natural alternative." Hancock Timberland Management Group. Downloaded April 9, 2006 from http://www.ucs-edu.net/Invst_Mgmt/Cambridge/16.pdf

Block, N. and Sample, V. A. (2001). "Industrial timberland divestitures and investments: Opportunities and challenges in forestland conservation". Washington: Pinchot Institute for Conservation. Downloaded April 9, 2006 from http://www.pinchot.org/publications/discussion_papers/timber.pdf.

Browning, E. S. (November 4, 2005). U.S. Timberland Gets Pricey As Big Money Seeks Shelter. *Wall Street Journal*. A1.

Burbach R. and Robinson, W. (1999). The fin de siecle debate: Globalization as epochal shift. *Science and society*. Spring, 1999. Downloaded April 12, 2006 from http://www.globalpolicy.org/globaliz/define/findesie.htm

Burkett, P. (1999). *Marx and nature: A red and green perspective*. New York: St. Martin's Press.

Carr, M. (2006). Emission prices drop to 13-month low after Sweden shows surplus. Bloomberg. Downloaded May 10, 2006 from http://www.europeanclimateexchange.com/

Chancellor, E. (1999). *Devil take the hindmost: A history of financial speculation*. New York: Plume.

Chicago Climate Exchange (May 4, 2006). CCE and Baxter Healthcare Corp. execute first transaction linking greenhouse gas emission trading systems in Europe and North America. Downloaded May 10, 2006 from http://www.europeanclimateexchange.com/

Clark, B. and York, R. (August, 2005). Carbon metabolism: Global capitalism, climate change and the biospheric rift. *Theory and society*. 34(4) 391 - 428.

Cronon, W. (1983). *Changes in the land: Indians, colonists and the ecology of New England. New York: Hill and Wang.*

Cronon, W. (1991). *Nature's Metropolis: Chicago and the Great West*. New York: W. W. Norton.

Cronon, W. ed. (1995). *Uncommon ground: Toward reinventing nature*. New York: W.W. Norton.

Crosby, A. W. (2004). *Ecological imperialism: The biological expansion of Europe, 900 - 1900 (2nd ed.)*. Cambridge: Cambridge University Press.

Dampier, C. (2005). "Betting on the weather." *Yale Economic Review*. Fall, 2005. Downloaded April 9, 2006 from http://www.yaleeconomicreview.com/issues/fall2005/weather.php

Davis, J. (1998). Rethinking globalization. *Race and Class*. 40(2-3). London: Institute of Race Relations.

Davis, J. (2000). The end of value. Paper presented at the Marxism 2000 conference, Amherst, MA, September, 20002. Downloaded May 12, 2006 from http://www.gocatgo.com/texts/eov.html

Davis, J. (2002). Speculative capital. Paper presented at the Global Studies Association meeting, Chicago, May, 2002. Downloaded February 26, 2006 from http://www.gocatgo.com/texts/globalization.networks.pdf

Davis, J. (2005). Networks and globalization. Paper presented at the Global Studies Association meeting, Knoxville, TN, May, 2005. Downloaded February 26, 2006 from http://www.gocatgo.com/texts/globalization.networks.pdf

Davis, M. (March - April, 2004). Planet of slums. *New left review*. 26. Downloaded May 12, 2006 from http://www.newleftreview.net/NLR26001.shtml.

Deweese, C. (November 4, 2005). REITs Spread to Timber Industry. *Wall Street Journal*. Downloaded April 9, 2006 from http://online.wsj.com/article/SB113107336791088187.html

Dyer-Witheford, N. (1999). *Cyber-Marx: Cycles and circuits of struggle in high-technology capitalism*. Urbana, IL: University of Illinois Press.

Erickson, A. and Rinehart, J. (2005). "Private forest landownership in Washington state." Seattle: University of Washington College of Forest Resources Northwest Environmental Forum.

Flannery, T. (2005). *The weather makers: How man is changing the climate and what it means for life on earth*. New York: Atlantic Monthly Press.

Foster, J. B. (1999). *The vulnerable planet: A short economic history of the environment.* New York: Monthly Review Press.

Frieden, J. (2006). *Global capitalism: Its fall and rise in the twentieth century*. New York: W. W. Norton.

Gollier, C. (2005). Some aspects of the economics of catastrophe risk insurance. CESIFO Working paper no. 1409. (Downloaded April 9, 2006 from http://www.cesifo-group.de/~DocCIDL/cesifo1_wp1409.pdf)

Gorvett, R. (1999). Insurance securitization: The development of a new asset class. 1999 Casualty Actuarial Society "Securitization of Risk" Discussion Paper Program. Downloaded May 8, 2006 from http://www.casact.org/pubs/dpp/dpp99/99dpp133.pdf

Grimes, P. and Kentor, J. (2003). Exporting the greenhouse: Foreign capital penetration and C02

emissions, 1980 - 1996. *Journal of world systems research*. 9(2), 261 - 275.

Harvey, D. (2001). *Spaces of capital: Towards a critical geography*. New York: Routledge.

Hagan, J., Project Leader; Irland L. and Whitman A. (2005). "Changing forestland ownership patterns in the northern forest and implications for biodiversity". National Commission on Science for Sustainable Forestry. Downloaded April 9, 2006 from http://www.ncseonline.org/ewebeditpro/items/O62F7183.pdf

Henwood, D. (April, 2001). The "New Economy" and the speculative bubble: An interview with Doug Henwood. *Monthly review*. 52(11).

Heynen, N. and Perkins, H. A. (March, 2005). Scalar dialectics in green: Urban private property and the contradictions of the neoliberalization of nature. *Capital nature socialism*. 16(1) 99-113.

Heynen, N. and Robbins, P. (March, 2005). The neoliberalization of nature: governance, privatization, enclosure and valuation. *Capital nature socialism*. 16(1) 5-8.

Hughes, J. D. (December, 2005). Global environmental history: The long view. *Globalizations*, 2(3) 293-308.

Intergovernmental Panel on Climate Change (2001). *Climate change 2001: Synthesis report*. IPCC. Downloaded June 5, 2006 from http://www.ipcc.ch.

Jaffee, D. M. and Russell, T. (1996). Catastrophe insurance, capital markets and uninsurable risks. Wharton School Working Paper 96-12. Downloaded May 8, 2006 from http://fic.wharton.upenn.edu/fic/papers/96/9612.pdf.

Jones, C., Lawson, J. H. and Shachak, M. (October, 1997). Positive and negative effects of organisms as physical ecosystem engineers. *Ecology*. 78(7) 1946-1957.

Keppler, F., Hamilton, J. T. G., Brass, M. and Reickmann, T. (January 12, 2006). Methane emissions from terrestrial plants under aerobic conditions. *Nature*. 439(187-191).

Kick, E. L. and Jorgenson, A. K. (2003). Special issue: Globalization and the environment. *Journal of world systems research*. 9(2) 195-203.

Kovel, J. (2002). *The enemy of nature: The end of capitalism or the end of the world?*. London: Zed Books.

Knohl, A., Schulze, E., Kolle, O. and Buchmann, N. (2003). Large carbon uptake by an unmanaged 250-year-old deciduous forest in Central Germany. *Agricultural and forest meteorology*. 118(2003) 151-167.

Li, Y. (2005). Comparing soil organic carbon dynamics in plantation and secondary forest in wet

tropics in Puerto Rico. *Global change biology* 11(2).

Liodakis, G. (2005). The new stage of capitalist development and the prospects of globalization. *Science & society*. 69(3), p341 - 366. July, 2005.

Lohmann, L. (September, 2005). Marketing and making carbon dumps: Commodification, calculation and counterfactuals in climate change mitigation. *Science as culture*. 14(3) p. 203-235.

Longworth R. (2004). The political city, in Madigan, C. (ed.) (2004). Global Chicago Chicago: University of Illinois Press

Malin, J. (1948). Ecology and history. In Swierenga, R. P. (ed.) (1984). *History and ecology: Studies of the grassland*. Lincoln, NE: University of Nebraska Press.

Marx, K. (1981). *Capital: A critique of political economy.* Vol. III. London: Penguin Books.

Marx, K. (1859). Preface, A Contribution to the Critique of Political Economy. Retrieved January 23, 2006 from http://www.marxists.org/archive/marx/works/1859/critique-pol-economy/preface-abs.htm.

McNeill, J. R. (2000). *Something new under the sun: An environmental history of the twentieth-century world*. New York: W. W. Norton.

Merchant, C. (1987). The theoretical structure of ecological revolutions. *Environmental Review*. 11(4) p. 265-271.

Merchant, C. (1989). *Ecological revolutions: nature, gender, and science in New England.* Chapel Hill, NC: University of North Carolina Press.

Merchant, C. (1995). Reinventing Eden. In Cronon, W. (Ed.), *Uncommon ground: Toward reinventing nature*. New York: W.W. Norton.

Millennium Ecosystem Assessment (2005). *Ecosystems and human well-being: Biodiversity synthesis*. Washington, DC: World Resources Institute. Available online at http://www.millenniumassessment.org/proxy/Document.354.aspx.

Mills, E. (August 12, 2005). Insurance in a climate of change. *Science*. 309(5737) p. 1040 - 1044.

Mulford, M. R. (1997). A brief historiography of environmental history. Downloaded May 3, 2006 from http://www.frontiernet.net/~mmulford/ehisthst.htm.

O'Connor, J. (1998). *Natural causes: Essays in ecological Marxism*. New York: The Guilford Press.

Oosthoek, J. and Gills, B. K. (December, 2005). Humanity at the crossroads: The globalization of the environmental crisis. *Globalizations*. 2(3) 283 - 291.

Pregitzer, K. S. (2004). Carbon cycling and storage in world forests: biome patterns related to forest age. *Global change biology*. 10(12).

Rahmstorf, S., Mann, M., Benestad, R., Schmidt, G. and Connolley W. (2005). Hurricanes and global warming - Is there a connection? Downloaded May 9, 2006 from http://www.realclimate.org/index.php?p=181.

Reich, P. B., Hobbie, S. E., Lee T,, Ellsworth, D. S., West, J. B., Tilman, D., Knops, J. M. H., Naeem, S., Trost, J. (April 13, 2006). Nitrogen limitation constrains sustainability of ecosystem response to CO2. *Nature*. 440, 922-925.

Reinsborough, P. (2004). Global ecology! Global democracy! Now! In Solnit, D. ed. (2004). *Globalize liberation: How to uproot the system and build a better world*. San Francisco: City Lights.

Robbins, P. and Luginbuhl, A. (March, 2005). The last enclosure: resisting privatization of wildlife in the western United States. *Capital nature socialism*. 16(1) 45 - 61.

Robinson, W. I. (2004). *A theory of global capitalism*. Baltimore: The Johns Hopkins University Press.

Saber, N. (1999). *Speculative capital* (Vol. I). Harlow: Pearson Education Limited.

Sande, J. B. (2002). "Restructuring and globalization of the forest industry: A review of trends, strategies and theories". Downloaded April 9, 2006 from http://www.rnr.lsu.edu/lfpdc/unece/Marketting/documents/Globalization%20of%20the%20Forest%20Industry.pdf

Sandor, R. (September 2, 2005). Lessons learned at Chicago Climate Exchange. *Sustainable industries*. Downloaded April 17, 2006 from http://www.sijournal.com/commentary/1708146.html

Schwartzman, D. (2006). How is entropy relevant to global sustainability?: A case study of the misuse of thermodynamics in red green theory. Downloaded May 11, 2006 from http://www.redandgreen.org/Documents/How_is_entropy_relevant.htm.

Shellenberger, M. and Nordhaus, T. (2004). The death of environmentalism. Downloaded May 11, 2006 from http://www.grist.org/news/maindish/2005/01/13/doe-reprint/

Shiller, R. (2003). *The new financial order: Risk in the 21st century*. Princeton: Princeton University Press.

Simmons, I. G. (1993). *Environmental history: A concise introduction*. Oxford: Blackwell.

Simmons, I. G. (1996). *Changing the face of the earth: Culture, environment, history* (2nd ed.). Oxford: Blackwell.

Simmons, I. G. (2003). Society and environment: Thinking about the global scale. Paper presented at World System History and Global Environmental Change conference, September 19 - 22, 2003, Lund University, Sweden. Downloaded April 24, 2006 from http://www.humecol.lu.se/woshglec/papers/simmons.doc

Sivanandan, A. and Wood, E. M. (February, 1997). Capitalism, globalization, and epochal shifts: an exchange. *Monthly Review*. 48(9).

Steffen, A. N. (May, 2006). The next green revolution. *Wired.* 14.05.

Stevis, Dimitris (2005). The globalizations of the environment. *Globalizations*. 2(3), 323 - 333.

U, K. T. P. , Falk, M., Suchanek, T. H., Ustin, S. L., Chen, J., Young-San Park, Y., Winner, W. E., Thomas, S. C., Hsiao, T. C., Shaw, R. H., King, T. S., Pyles, R. D., Schroeder, M. and Matista, A. A. (2004). Carbon dioxide exchange between an old-growth forest and the atmosphere. *Ecosystems*. 7(5), 513-524.

United Nations Environment Programme (1999). *Global environment outlook 2000 overview*. Downloaded May 18, 2006 from http://www.unep.org/geo2000/ov-e/ov-e.pdf

United Nations Environment Programme (2006). *GEO yearbook 2006*. Downloaded May 18, 2006 from http://www.unep.org/geo/yearbook/yb2006/PDF/Complete_pdf_GYB_2006.pdf

U.S. Department of Energy (2005). *United States, Annual data for 1949-2003 (thousand British thermal units per chained (2000) U.S. dollars)*. Retrieved January 22, 2006 from http://www.eia.doe.gov/emeu/aer/txt/ptb0105.html.

van Kooten, G. C., Eagle, A. J., Manley, J. and Smolak, T. (2004). How costly are carbon offsets? A meta-analysis of carbon forest sinks, *Environmental Science & Policy* 7(4 August): 239-51.

Warner, M. (2002). Interview with Frank Michel. *Newshour with Jim Lehrer transcript*. Downloaded June 4, 2006 from http://www-c.pbs.org/newshour/bb/business/jan-june02/lay_2-12.html.

Werbach, A. (2005, June 21). Environmentalism is dead. What's next? *In These Times.* June 21, 2005. Retrieved January 5, 2006 from http://www.inthesetimes.com/site/main/article/2171/

World Resources Institute (1999). The changing global financial architecture: Environmental threats and opportunities. Roundtable discussion hosted by the WRI Institutions and

Governance Program International Financial Flows and the Environment Project. Washington DC: World Resources Institute. Downloaded May 20, 2006 from http://pdf.wri.org/iffe_gfareport.pdf.

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