Chapter 17

The Production of Nature

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It may seem strange to include a chapter on the production of nature in a volume about economic geography.[1] After all, according to common-sense understandings of the term, "nature" is the antithesis of society and thus, by definition, incapable of being "produced" by humans within their economic systems (as opposed to, say, being altered or disturbed). Indeed, as if to confirm this, economic geographers have traditionally had relatively little to say about the question of nature. Although geography has long been concerned with human–environment relations, the post-war division of the discipline into human and physical, divided in turn into various thematic specialisms, compartmentalized geographical inquiry. Economic geographers thus pushed to the margins the putatively "non-economic" and, as Martin (1995) notes in a recent survey, organized their research around the twin themes of industrial location dynamics and processes of uneven development, drawing variously upon the theoretical resources of neoclassical, Keynesian, and Marxian economics. Where nature appeared at all, it was usually as part of (an ongoing) minority interest in the spatial and organizational structure of particular resource industries (see, for example, O'hUallachain and Matthews, 1996, on the topic of copper mining). From the perspective of post-war economic geography, then, questions of nature and environment were best left to physical geographers or else to those human geographers who specialized in resource and environmental management. This subdisciplinary blindness to nature did not, however, only reflect the compartmentalization of geographical research. It also reflected the "eco-blindness" of the economists and the economic theories upon which economic geographers drew for inspiration. The neoclassical, Keynesian, and Marxian approaches had little to say about nature and environment, a characteristic also true of less popular approaches such as institutionalist economics. Accordingly, economic geographers treated the economy as a relatively discrete (even closed) system with its own dynamics, the geographical patterning of which was to be the subject of inquiry.

In recent years, though, this has started to change (how else could I write this chapter?). Since the early 1980s a growing number of economic geographers have put nature at the center of their inquiries. A key reason for this shift of focus is the

increasingly obvious impact of existing economic systems on the natural world, notably capitalism, which is arguably the dominant mode of producing goods and services worldwide. Some economic geographers see these systems as largely responsible for a plethora of current environmental problems – from local problems like lake eutrophication in UK farmlands to global problems like greenhouse warming – while others consider them central to some of the new and very deep transformations of nature which, until recently, seemed to be the stuff of science fiction. A good example of this is genetically modified (GM) foods, labeled by British critics as "Frankenfoods" during the public controversy over their growth and sale in 1999, and which involve multinational corporations like Monsanto reconstituting nature down to the genetic level in the interests of profitability.

In the face of these epochal eco-transformations, several economic geographers have developed a provocative approach which regards them as instances of the "production of nature." This approach, as we shall see, is associated with Marxian economics and Marxist geography (see Swyngedouw, this volume) and is part of a broader "political-economy" approach to nature and environment. As the couplet of "production" and "nature" suggests, it opens up the typically closed models of economic geography by insisting that economy and ecology are indissolubly intertwined. Accordingly, this approach regards many current ecological problems and transformations less as human tamperings with an external nature than as the planned and unplanned outcomes of a single (if complex) process of the economic production of nature under the dominant global production system, capitalism. This is not to say that nature is only produced within capitalism (for there are non-capitalist modes of producing nature too), but it is to say that, according to the production of nature approach, capitalism is today the most powerful and transformative economic system in relation to nature and environment. Critical, as well as explanatory, the production of nature approach contests the social and ecological consequences of this capitalism. As such, it seeks a new economic order based upon more socially and ecologically just and sustainable principles. To understand it – and its limitations – we begin by considering one of the dominant understandings of nature within geography, one that the production of nature approach opposes.

From Technocentrism to Ecocentrism: Externalizing Nature

The human use of environment and nature preoccupies government, business, and civil society like never before. This recent wave of eco-concern originated in the late 1960s just before the so-called "long post-war boom" enjoyed by Western and several non-Western countries ground to a halt in the face of the global recession of the early 1970s. Writing in 1966, the economist Kenneth Boulding was among the first to warn of the serious environmental costs of unrestricted economic growth. For him, most nations at that time were running a "cowboy economy" rather than a more sensible "spaceship economy" based on an appreciation of the ecological limits to growth. Over 30 years on, as resource depletion continues, as environmental problems multiply, and as developments like GM foods remake nature "all the way down," the burgeoning environmental movement is divided between a "technocentric" wing and an "ecocentric" wing, each with rather different views on nature and its economic usage by humans. (For a detailed consideration of the two wings

see O'Riordan, 1989, 1995). Both wings can be found in geography, especially the former which underpins much environmental geography and resource management. And, as will now be shown, both wings share a conception of nature that the production of nature approach seeks to question and criticize.

Technocentrists put humans first, that is, they are anthropocentric. Though they acknowledge that problems exist in the way people use nature and environment, especially in highly industrialized capitalist countries like the USA or UK, they argue that these problems admit technical and administrative solutions. Indeed, some technocentrists have faith that science and technology can even *improve* nature in the interests of human well-being. In other words, technocentrists embrace the existing economic, political, and social order, and propose only to tinker, rather than to dismantle it, in the interests of better environmental management geared to human needs. Broadly speaking, there are three groups of technocentrists. Neo-Malthusians are the most pessimistic, and argue – following the earlier work of the early nineteenth-century economist, demographer, and reverend Thomas Malthus – that drastic reductions in the levels of population and economic growth are needed to avert eco-catastrophe (see, for example, Meadows and Meadows, 1992). At the other end of the technocentric spectrum are optimists, or Cornucopians, who argue that economic growth is an impetus for technical innovation and the timely exploitation of new resources when resource scarcity threatens (see, for example, Simon, 1997). Finally, somewhere in the middle are (in the practical domain) most environmental and resource managers and (in the academic domain) most environmental and resource geographers. In this middle ground one also finds the majority of those advocating the elusive, if appealing, notion of "sustainable development" (see Redclift, 1991).

By contrast, ecocentrists put nature first and argue for a more harmonious human–nature relationship. Ecocentrists worry that we are currently witnessing *The End of Nature* (McKibben, 1989) at the hands of capitalist "growthmania" (as economist Herman Daly, 1973, p. 151 famously called it) and propose to "save" and "preserve" nature. Most ecocentrists lie outside the political mainstream and, though some enjoy degrees of respectability and support (for instance, Greenpeace or the German Green Party), many ecocentric groups (like fox hunt saboteurs, "tree huggers" and the whale-ship ramming Sea Shepherds) are considered more-or-less extreme opponents of existing ways of life. Indeed, many "deep greens" – like the radical organization Earth First! – argue for the wholescale dismantling of today's industrial, technological, capitalist societies in favor of more eco-friendly, small-scale ways of living.

As we shall see, advocates of the production of nature argument try to combine the environmental sensibilities of ecocentrists with a less anthropocentric version of technocentrism. For the moment what is more interesting is the commonality between the seemingly opposed technocentric and ecocentric worldviews. For, from the perspective of the production of nature argument, what the technocentrist "manage/improve nature" and the ecocentrist "save nature" rhetorics share is the questionable assumption of an *external nature*. In both cases "nature" is invoked as a separate realm which acts as source of authority to legitimate existing or even new economic, social, and environmental arrangements. For instance, neo-Malthusians invoke the notion of fixed "natural limits" to growth in order to call for draconian

restrictions on births and consumption levels. Likewise, deep greens complain that certain new technological developments – like GM foods – are "unnatural" and should be opposed on ecological and moral grounds. The economic geographer who has most strenuously articulated the production of nature argument – Neil Smith – argues that this putative externalization of nature amounts to nothing less than an "ideology of nature" (Smith, 1984). It is an "ideology" because not only is it incorrect or false but it actively blinds us to the realities of nature within modern capitalism. It is a pervasive ideology, Smith argues, but one that well serves dominant capitalist interests. Its ideological content, he suggests, derives from its deliberate refusal to acknowledge the reality of a nature fully *internalized* within existing socio-economic relations and processes. Of course, there are still parts of the world where a more or less pristine "first nature" remains, but Smith's point is that today this first nature is increasingly subsumed to an economically produced "second nature."

The Production of Nature

At first sight it may seem odd to argue that nature is produced economically. As (Smith, 1984, xii–xiv) concedes, the notion of a "produced" second nature "sounds . . . quixotic and . . . jars our traditional acceptance of what had hitherto seemed self-evident . . . it defies the conventional, even sacrosanct separation of nature and society, and it does so with such abandon and without shame." However, for Smith the production of nature idea only seems odd because the nature–society dualism underpinning technocentric and ecocentric thinking about the environment has such a powerful ideological grip on our imaginations. In dissolving this dualism, the production of nature approach directs our attention not to how modern societies merely "interact with", "interfere with" or "upset" nature and environment, since each of these terms implies an asymmetrical relationship between two ostensibly separate domains. Instead, it seeks to show that nature and society are "inner-related" *from the very start*.

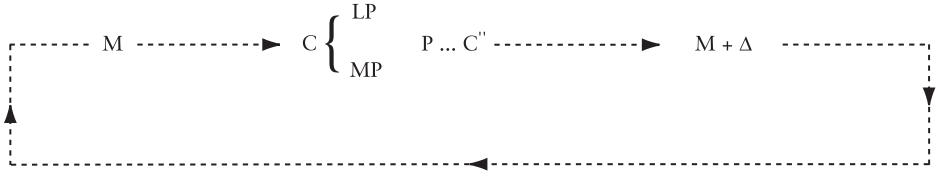
As noted in my introduction, the production of nature approach focuses mainly on the role of modern capitalism in producing nature and, theoretically and intellectually speaking, is closely associated with Marxism. Though the approach was first popularized in economic geography by Smith, its origins can be traced back to an influential essay by the geographer David Harvey (1974), entitled "Population, resources and the ideology of science." Writing in the context of the pervasive neo-Malthusianism of the early 1970s, Harvey rejected the commonly accepted argument that "Over-population arises because of the scarcity of resources available for meeting the subsistence needs of the mass of the population" to insist instead that:

> . . . there are too many people in the world because the particular ends we have in view (together with the form of social organization which we have) and the materials available in nature, that we have the will and the way to use, are not sufficient to provide us with those things to which we are accustomed (Harvey, 1974, p. 274).

In this way, Harvey sought to draw attention away from the "limits" supposedly dictated by an intransigent, external nature to suggest, instead, that ecological limits

were *relative* to the specific socioeconomic systems in place at any one time and place. He thus showed that food scarcity was rarely absolute and that the dubious notion of "over-population" should be replaced with the Marxist notion of "relative surplus population."

Building on this, a set of other Marxist geographers subsequently tried to flesh out the general implications of Harvey's position (Burgess, 1978; Sayer, 1979; Smith and O'Keefe, 1980). This culminated in Smith's (1984) germinal work *Uneven Development*. Not only did Smith seek to offer a theory of the dominant economic system – capitalism – to which Harvey's essay had only gestured, but he was also the first to talk about the capitalist "production of nature." Following Marx, Smith's theory sets out to explain, from a geographical viewpoint, the functioning of capitalism as a specific mode of economic production. Put simply, capitalist production takes the following form:



where M (money) is put forward to purchase C (commodities) – namely, MP (means of production: inputs, machines) and LP (labor power) – which are combined in the productive process (P) to produce a new commodity (C′), which is then sold for the original money put forward, plus a profit (Δ). The profit is then reinvested to enable a new round of production. Note that on this reading, capitalist production is processual: it is in motion, not stasis. Note too that "production" refers not merely (and narrowly) to what occurs in the factory, farm, or office, but to the whole, wider *system* of commodity purchase, transformation, distribution, exchange, and sale.

In this system, which Harvey (1985, p. 3) calls "the primary circuit of capital," commodities are produced not simply for their practical – or use – value, but also for their exchange value. After Marx, Smith argued that four cardinal features characterize this system. First, it is inherently growth-orientated: profit, rather than, say, social equity or environmental sustainability, is the primary goal. Second, it is based on competition between capitalists within and between industrial sectors as they fight to sell their products to consumers in regional, national, and world markets. Third, growth and competition set up powerful incentives for individual capitalists to maximize their returns in whatever way possible (e.g. through exploiting new locations or technological innovation). Finally, the origin of profit lies in labor, rather than any other factor of production. The "surplus value" realized at the end of the primary circuit of capital thus originates with laborers, whose work is exploited in the form of surplus labor time over and above that for which they are paid.

Smith innovatively drew out the geographical implications of this capitalist form of production. For him, it embodies opposing tendencies toward the geographical equalization and differentiation of production, or what he calls *uneven development*. Production must always be place-based: it has to occur somewhere. But

Smith's point is that this *differentiated* economic landscape is undermined by an opposed tendency to *equalization* as capitalists eventually look for new locations where they are able to produce more profitably. Uneven development thus emerges as a systematic – rather than incidental – aspect of capitalism.

What has all this to do with nature? At first sight very little. First, as I have said, nature is usually taken to be external to society and so incapable of being produced. Second, nature barely figures in the Marxist theory upon which Smith based his argument. Nonetheless, Smith insisted that Marx's theory is profoundly relevant to nature. Why? Because:

> . . . with the progress of capital accumulation . . . this material substratum [nature] is more and more the product of social production, and the dominant axes of differentiation are increasingly societal in origin. In short, when th[is] . . . immediate appearance of nature is placed in historical context, the development of the material landscape presents itself as a process of the production of nature (Smith, 1984, p. 32).

In other words, notwithstanding Marx's neglect of nature, nature is in fact relevant to his theory from the very start. Smith's point is that once capitalism forges a relation to nature, the latter loses its seeming externality and becomes a socially produced "second nature" which becomes one "moment" within the wider dynamics of capital accumulation. Specifically, the labor process becomes the flashpoint for a socio-natural dialectic in which "nature is mediated through society and society through nature" (ibid., p. 19). The reason is not just because labor is the most *immediate* point of economy–nature interaction. More technically, in Smith's Marxian vision, each specific – or concrete – labor process involving nature (e.g. growing barley in the UK) is measured according to a general – or abstract – labor magnitude which is formed as the average labor time of myriad concrete labors within a given economic sector (e.g. the growth of barley worldwide). In this way, differential labors on different environments in different places become tied to capitalism in general (a local–global dialectic). And in this way, too, specific agricultural and industrial complexes involving the production of nature become subject to the pressures of differentiation and equalization identified by Smith (uneven development).

The ''Production'' of Nature?

If all this still seems counter-intuitive and confusing, it is perhaps worth saying a little more about the meaning of the term "production" in order to clarify matters further. Production is a portmanteau concept: it carries multiple meanings. It is thus necessary to "unpack" it into its component parts. First, production varies historically and geographically. I mention this again because it is important to distinguish capitalist from *non-capitalist* forms of nature's production. In economic geography, it is the capitalist production of nature that has been the center of attention. Traditional and socialist modes of production produce nature – and resource and environmental problems – very differently, and thus must not be elided with capitalism. Secondly, we can distinguish "weak" from "strong" production. The production of nature argument may seem to imply that nature is infinitely malleable in the hands of capitalism. However, as sectors like agriculture, minerals, and metals show,

the material properties of nature remain fundamentally important to the capitalist production system which appropriates them. Thus the weaker version of the production of nature argument simply asserts "that the use of natural substances by people depends upon a whole series of social processes. These include: (1) technologies that alter our capability to use materials, (2) capital investment and disinvestment, (3) markets, (4) transportation, (5) credit institutions, and (6) government . . . programs" (Roberts and Emel, 1992, p. 260). However, as we approach a new millennium a stronger version of the argument increasingly applies. Today, many nature-based industries have the power to literally reconstitute nature in pursuit of profit. Aside from the example of GM foods already mentioned, one can cite other biotechnological developments such as the use of growth hormones in animal feeds and even, after Dolly the sheep, the cloning of farm animals (see Mannion, 1992). Again, though, this does not deny the material importance of the transformed natural substances. It does, however, point to the remarkable depth of capitalism's production capacities.

Thirdly, it is useful to distinguish capitalist production in the "narrow" and the "extended" sense. I have already referred to this above in passing. Under capitalism, nature is not just produced in the factory or the farm. Rather, what happens in the labor process is directly dependent upon how it is tied to the purchase of inputs, to external markets, to transportation networks, to rival firms, and so on. Production is thus *systemic*. Finally, the production of nature is complex and uneven. At one level this is due to natural differentiation reflecting the myriad different resources and environments on which capitalism draws. However, during the last century this "natural differentiation" has become systematized into patterns of socially produced uneven development by capitalism as different nature-based industries commodify different aspects of nature and seek to sell their products in competitive markets.

As a way of concretizing the rather general, abstract claims of this and the preceding section I now want to present two examples of nature's production under capitalism. Each example highlights different aspects of this production and together both suggest the intellectual and political benefits of thinking about economy–nature relations in a non-dualistic way. Specifically, the first example shows the limits of technocentrist thinking by looking at a common type of environmental problem usually seen as the by-product of economic growth, while the second example shows the limits of ecocentrist thinking by looking at a case (of which there are today more and more) where capitalism materially remakes nature to the point that it is no longer "natural."

Water and Uneven Development in the Southwest USA

The first example is drawn from the work of American economic geographers Roberts and Emel (1992) on irrigated agriculture and groundwater extraction in the post-1945 Southern Plains of Texas and New Mexico. The Plains possess rich soils but are served by unreliable and sparse precipitation. Consequently, in the post-war years the considerable agricultural expansion in the area has depended on irrigation water drawn from the massive Ogallala aquifer which underlies the Plains. Since the early 1970s though, water shortages have resulted from over-use of the aquifer, with water levels falling by as much as 50 meters in some areas. Roberts and Emel show that most

water managers have seen these shortages as a "tragedy of the commons" problem. In other words, shortages are seen to stem from the fact that since no one farmer owns the Ogallala water – it is a common or open-access resource – all are free to use it without restriction. Since a given farmer reasons that if s/he does not use the water her/his neighbors will, it is "rational" for him/her to use water without thinking of the overall impacts of this on aquifer levels. The "tragic" result is that in the long term farmers inadvertently harm both themselves and their competitors since water shortages are suffered by almost everyone. In short, what is individually "rational" ultimately proves to be economically and environmentally "irrational."

The "tragedy of the commons" theory is widely used to explain the over-exploitation of natural resources in geography and resource management. The solutions stemming from it entail either privatizing the resources (the assumption being that if someone owns what is presently an unowned resource, like the Ogallala water, they will have a vested interest in conserving it) or getting the state to regulate their use to ensure sustainable exploitation. However, Emel and Roberts argue that there are three problems with these technocentrist explanations and solutions in the Southern Plains case (and the many cases of resource over-use like it worldwide). First, water is seen as a fixed or finite resource which suffers the inadvertent impacts of farmers trying to make a living, as if economy and nature were two realms that exist independently prior to being brought together. Second, water shortages are seen as essentially a property rights problem: it is the lack of property rights in water that is the economic root of the shortages/over-usage. Finally, dealing with water shortages does not entail any fundamental challenge to the structure of agriculture in the Southern Plains but, rather, a slight modification of ownership rules.

Against this, Roberts and Emel seek to put empirical flesh on the theoretical bones of Smith's (1984) argument in *Uneven Development* by seeing Plains water problems as a case of the capitalist production of nature. This may seem odd since water can hardly be "produced" by the farmers in question: it already exists in the Ogallala aquifer. So what do Roberts and Emel mean? To begin, they point out that aquifer water has only become a "resource" in the post-war years when sufficiently powerful mechanized water pumps have been able to tap the Ogallala. Likewise, many of the water shortages from the 1970s onward were not *absolute* but *relative* since they arose from the fact that many farmers could no longer afford to pump deep water because of a sharp rise in fuel prices at the level of the world economy. As Roberts and Emel (1992, p. 60) aptly put it, "The concept of 'natural' resources risks attributing usefulness to this finite substance rather than to a complex interaction between social relations of people and biophysical characteristics." What, then, are the social relations in question? Following Smith, Roberts and Emel argue that looking at property rights is superficial and suggest instead a deeper explanation to do with the form of capitalist production. Given the fact of crops being sold in a competitive market in pursuit of profit, water depletion is for Roberts and Emel best explained by the "cost-price" squeeze that Plains farmers faced from the early 1970s onwards due to competition from cheaper Midwestern farmers, and the sharp increase in fuel prices just mentioned. It was this squeeze, rather than merely a lack of local property rights, which for Roberts and Emel set off a competitive scramble to appropriate Ogallala water and to develop new technological means of doing so. In turn, this competition generated new patterns of uneven agricultural

development in which new water-rich areas were farmed until aquifer levels declined, and then still newer areas exploited in a remorseless quest for profitability. For Roberts and Emel, water shortages can only be understood *in relation to* capitalist production, not separate from it. Moreover, because of the environmentally rapacious effects of capitalist production, the ultimate solution to Plains water shortages lies not in allocating property rights but, more fundamentally, in abolishing capitalism altogether (see Castree, 1997, for a similar example of a produced environmental problem).

Producing Food, Privatizing Nature

The second case study is also agriculture-related but is less about an economically produced environmental problem and more about capitalism's increasingly deliberate ability to remake nature "all the way down" in the pursuit of profitability. Where Roberts and Emel examined a case of the "weak" production of nature, in the sense I defined earlier, Jack Kloppenburg's (1998) *First the Seed* investigates an altogether "deeper" production of nature. His book reveals how a set of American agro-foods corporations quite literally "remade" the seeds upon which much US and world agriculture has been based this century. In light of the recent concern over the moral, environmental, and nutritional propriety of developing GM crops and the like, Kloppenburg's analysis stands as a useful counterpoint to ecocentric critiques of these crops which base their arguments on the supposed "unnaturalness" of the foods derived from them. I say this because *First the Seed* shows that GM foods are by no means the first attempts this century to reconstitute nature at the most basic levels in the interests of profitability. For, contrary to popular understandings, many of the foods (such as corn, tomatoes, and soya) that are now being genetically altered through gene-splicing and other new recombinant methods have for a long time been engineered and re-engineered by agro-corporations. In other words, far from being "natural" foods which are only now being "corrupted" by GM technology – as in the ecocentric view – these foods have been "second natural" for decades and part and parcel of twentieth-century capitalism. The point is that the new gene-technologies are only taking a stage further an older, established process of actively producing commercial foods rather than simply "growing" "natural varieties."

First the Seed focuses on the production of hybrid corn in the USA, long a world leader in commercial farming. Grown on a large scale in the USA from the late 1930s onwards, hybrid corn was one of the precursors to the later "Green Revolution" in the developing world and one of the crops responsible for the massive expansion in US food output during the post-war years. However, its impacts extended far beyond food increases to include a set of profound social and environmental transformations which, in turn, stemmed from the commodification of a seemingly innocuous little thing: namely seed. I say "seemingly innocuous" because seed is in fact of central importance to US and world agriculture for obvious reasons. Prior to the 1930s, most seed in the USA was produced by farmers who would collect it from their annual harvest and use it to sow the next year's crop. Where new seeds for new crops were sought after, farmers usually went to the US Government which, through its many agricultural research stations and Land Grant Universities, became the main supplier of alternative – and free – seed types. In the USA, seed was

thus a "free good" during the early twentieth century and farmers generally had no need to purchase seed from commercial suppliers. Indeed, prior to the 1930s, this is why there was virtually no commercial seed supply industry in the USA. Until, that is, the discovery of hybrid corn.

Hybrid corn is higher-yielding than non-hybrid corn. This is why within a generation of its invention in the 1930s most US corn farmers had switched to hybrid varieties (by 1965, for example, 95 percent of US corn was hybrid compared to less than 1 percent in the early 1940s, yielding six times more corn per acre than the non-hybrid corn of the 1920s). In its natural, non-hybrid state, corn reproduces by open-pollination, meaning that an ear of corn is fertilized by the pollen of another plant, thus ensuring that a corn population is in a constant state of genetic flux. This flux, prior to the 1930s, constantly confounded efforts to develop and fix superior corn varieties. Hybridization was thus developed as a means of isolating desirable, high-yielding strains of corn. Based on the work of US state-sponsored agricultural researchers, hybridization entailed the controlled cross-breeding of so-called "inbred" corn plants in order to produce seeds that would grow into high-yielding crops. However, while the seeds grew into productive corn plants the seeds those plants produced were, for complex biological reasons, not nearly as productive as the parent seeds.

Though hybrid corn seems to have been an unalloyed good (it was hailed as a "miracle crop" by many), Kloppenburg shows that there was a darker side to the story. Specifically, hybridization became a tool with which new commercial seed companies could produce nature anew in order to privatize seeds and thus create a new market in seed sales where none existed before. First, the fact that hybrid, manufactured varieties produce seed of an inferior quality to their parent seeds became a technical means of dispossessing farmers of their traditional free access to seed for the next year's crop. As Kloppenburg (1988, p. 93) notes, "Hybridisation . . . uncouples seed as 'seed' from seed as 'grain' and thereby facilitates the transformation of seed from a use-value to an exchange-value. The farmer choosing to use hybrid varieties must purchase a fresh supply of seed each year." Indeed, between 1934 and 1944 a commercial seed supply industry grew up in the USA selling $70 million of hybrid seed-corn. Second, in addition to this way of using "second nature" to extract monies from corn farmers, the new commercial seed companies which grew up in the USA during the 1930s also heavily lobbied the national government in order to obtain patent rights in the invention of new hybrid varieties, beginning with the 1930 Plant Patent Act. As Kloppenburg shows, this was crucial if seed companies were to invest in research into new hybrids and then protect these hybrids from free use by farmers and rival seed companies.

In economic terms the production of hybrid corn was about far more than increased yields, taking a previously on-farm process off-farm, and thereby extracting profit from farmers who had heretofore used their own seed. Environmentally, hybridization also went (and has continued to go) hand-in-hand with a less genetically variable and more monocultural form of agriculture which has left some hybrids susceptible to pests and diseases unless protected by heavy doses of pesticides and herbicides. And, like hybrid seeds, during the post-war years these chemical treatments have been manufactured off-farm by agro-foods multinationals, thus removing a further aspect of farming from farmers' financial control. So it is that

First the Seed shows how the capitalist production of previously "natural" seed varieties became a powerful tool in reconfiguring the economic and ecological make-up of US agriculture (see also Goodman et al., 1987; Goodman and Redclift, 1991).

Intellectual and Political Strengths

The production of nature approach is clearly as rich in its implications as it is provocative in its arguments. Contrary to the technocentric and ecocentric world-views, many environmental problems and transformations of nature under capitalism are seen as produced, not problems and transformations of a separate economy impacting a separate, non-social ecology. This non-dualistic approach possesses some important intellectual and political strengths (see Castree, 1995, p. 19; Smith, 1996, p. 50). First, in disciplinary terms it shows clearly how and why questions of nature and environment ought to be central to economic geography today. Secondly, and less parochially, it reveals the political conservatism or, at best, liberalism of much technocentrism, since technocentrism rarely calls into question the capitalist economic system responsible for so many present day eco-transformations. Third, the production of nature approach also questions the romanticism of much ecocentrism since it shows the fallacy of trying to "save" a "first nature" that is, for the most part, already being reconstituted as a produced "second nature." Fourth, it powerfully historicizes – and thus relativizes – the socioeconomic relation to nature by showing that capitalist production is a phenomenon only of the last one and a half centuries or so and one that is by no means "natural" or inevitable. Fifth, it shows how one production system – capitalism – contains the inner complexity to link local and global produced natures and to generate uneven development between produced natural landscapes. Sixth, it shows the production of nature to have conjoint ecological and social consequences. Specifically, the exploitation of labor and the incidence of uneven development frequently go hand-in-hand with the active production of environmental problems or resource scarcity. Seventh, the production of nature approach shows capitalist production to be a highly political, non-neutral process with questionable socio-ecological outcomes. Finally, the approach opens up the possibility of envisaging a set of post-capitalist natures produced on more socially and ecologically egalitarian and sustainable lines.

Problems, Responses, and Prospects

There are, however, technical, theoretical, ontological, and political problems with the production of nature approach. Technically, technocentrists (like resource managers) and ecocentrists (like Greenpeace and other environmental NGOs) might legitimately complain that, in criticizing capitalism, advocates of the production of nature approach fail to offer any viable economic *solutions* to economically produced environmental/resource problems (Dietz and van der Straaten, 1995) other than the rather unrealistic notion of totally overthrowing capitalism. Theoretically, two problems loom large. First, even sympathetic critics complain that the production of nature approach is *productivist*. That is, it over-emphasizes production at the expense of other processes that simultaneously socialize nature (Braun and Castree,

1998, ch. 1). After all, production is in reality "embedded" in a set of non-economic and non-capitalist relations (Thrift and Olds, 1996). Secondly, far more work needs to be done on translating the abstract logics adumbrated by Smith into meso- and micro-level studies of particular productions of nature in particular places. Aside from the two case studies discussed above, this work is now being pursued in relation to a new "political economy of agriculture" in the developed world, which inserts agro-food production in different locales into wider circuits of global capital (see Brian Page, this volume).

Ontological issues also arise (an ontology is a theory of what exists or what is real). Central here is the suggestion that the production of nature approach is overly *anthropocentric* (and thus, ironically, in this respect similar to the technocentrists it criticizes). The charge has two components: first, that the approach causally prioritizes the capital "side" of the capital–nature dialectic; and second, that it therefore fails to appreciate the ecological and social seriousness of many of the current produced environmental/resource problems found worldwide (such as the currently unknown long-term health and environmental effects of GM foods which are now widely grown in the USA). These criticisms have some validity. After all, the production of nature approach was inspired by Marx's economics and Marx has been shown to be more interested in understanding the human consequences of capitalism than its environmental consequences (Castree, 1995, p. 19). Accordingly, geographers like Smith have looked more at how capitalism produces nature and less at how produced nature affects capitalism. In response, a number of Marxists outside geography have sought, at the theoretical level, to add to Marx's political-economy concepts a set of political-ecology concepts that can help us make sense of the material properties of produced nature (e.g. Altvater, 1993). Additionally, empirical work like Kloppenburg's study shows that not all past Marxian work on the production of nature has ignored nature's physical properties and effects. However, within geography much still needs to be done in this regard (but see Harvey, 1996).

Finally, the production of nature approach is also subject to political problems. One problem is its *Prometheanism* (Soper, 1991) in which, following the general Western Enlightenment view, nature is seen as but an end to human needs or happiness. For ecocentrists the production of nature approach – like Marxism more generally – cannot value nature in its own right (Hayward, 1995, ch. 3). A second problem, more controversially, is that the production of nature approach is *masculinist*. As several feminist critics have pointed out, Marxism's complicity in the Enlightenment question to "master" and control nature – albeit in a non-capitalist form – raises questions about its gender biases and subtexts. As a concept, nature has long been feminized in Western discourses, as a domain to be "conquered," "tamed," and "subdued." By prioritizing paid (predominantly male?) – as opposed to unpaid, domestic (female?) – labor as the force driving nature's production under capitalism, the production of nature approach may inadvertently perpetuate a social and environmental politics blind to women's unequal place in capitalist societies (Plumwood, 1994).

Production of nature advocates concede many of these criticisms (Castree, 1997; Smith, 1998). However – and this is an important point – they would insist that it is necessary and (in principle at least) possible to be *anthropomorphic* without being

anthropocentric and Promethean on the one side or, on the other side, ecocentric. Against "greens" who wish to value nature "in its own right" and technocentrists who put humans first, the production of nature approach implies that it is possible to *balance* human and ecological needs by recognizing that all appraisals of nature and what to do with it *are made by humans in the first place* (under capitalism or any other economic system). This anthropomorphic insight avoids the myth of any "return to nature" in itself without necessarily lapsing into the human-centered arrogance (anthropocentrism) of the technocentrics, since the argument is that while it is only possible to value nature in human terms – we simply cannot know what a non-human valuation of nature would look like since we cannot step outside our humanity – this fact does not preclude a more sustainable production of nature in which the environment is respected. And, from a Marxist viewpoint, a more sustainable production of nature will be a post-capitalist one in which unbridled economic growth and the exploitation of working people is a thing of the past.

Criticisms and responses aside, what of the future? Marxian theory has, of late, become less popular in human geography in general and economic geography in particular. Nonetheless, two notable developments promise to further disciplinary interest in the capitalist production of nature and to sustain the relevance of Marxian political ecology into the twenty-first century. The first is the agro-foods and biotechnology industries to which I have referred several times in this chapter. Gene-splicing and other new biotechnologies now promise to take a step further the capitalist production of myriad plant and animal natures as we enter a new millennium. As we have already seen in the UK controversy over GM foods, the social and ecological consequences of this intensified production of agrarian natures is likely to be profound and contested. Secondly, and more worrying perhaps, modern science and industry now collude to remake even the human body through genetic engineering, transplantations, and prosthetics. Is the production of *bodily natures* to become a crucial intellectual and political issue for the twenty-first century? (on this see the recent essays in *Society and Space*, 1998). And, if so, will the corporeal become a serious focus of intellectual and political concern for economic geographers in the years to come?

Endnote

1. In this essay I use the word "nature" unproblematically as, for the most part, a synonym for environment (although towards the end of the essay I extend the term to include the human body). In so doing I am deliberately side-stepping the complex task of defining nature, and refer readers who seek such a definition to Castree (2000).

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