Neoliberal environments: Crisis, counterrevolution, and the nature of value

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Abstract

This dissertation develops a genealogy of the environment as an object of politics through the period of neoliberal transition, roughly the late 1960s to the early 1990s. Through a series of case-studies highlighting critical moments in the modern history of the environment, I use archival research, literature analysis, and key informant interviews to show how our current understanding of the environment has co-evolved with some of the forms of governance we have come to associate most closely with neoliberalism. In contrast to existing scholarship, I show that the environment is not simply an object to which neoliberal policies have been applied, but a political problem that entails ongoing negotiations over the legitimacy of market rule, the role of the state in relation to the market, and the value of ecological stewardship. In this way the project challenges the conventional understanding of the relation between neoliberalism and the environment in geographical literature, as well as accounts of neoliberalism that marginalize or ignore environmental governance. In contrast, I show that the problem of nature's value has been central to neoliberalism from its inception, and remains a key site of politics in the present.

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Introduction: Neoliberal environments

I am sure you remember the plain citizen Jourdain in Moliere's Bourgeois Gentilhomme *who,* nouveau riche*, travels in the sophisticated circles of the French aristocracy, and who is eager to learn. On one occasion with his new friends they speak about poetry and prose, and Jourdain discovers to his amazement and great delight that whenever he speaks, he speaks prose. He is overwhelmed by this discovery: "I am speaking Prose! I have always spoken Prose! I have spoken Prose throughout my whole life!"*

A similar discovery has been made not so long ago, but it was neither of poetry nor prose—it was the environment that was discovered. I remember when, perhaps ten or fifteen years ago, some of my American friends came running to me with the delight and amazement of having just made a great discovery: "I am living in an Environment! I have always lived in an Environment! I have lived in an Environment throughout my whole life!"

– Heinz von Foerster, "On Constructing a Reality"[1]

When Heinz von Foerster related the above parable at the Fourth International Conference on Environmental Design Research in 1973, he distilled the revolution in systems science that had unfolded over the past decades into a key epistemological shift: an inquiry into things on the basis of their relation with their constitutive outside, the milieu that provides the conditions of their existence. At the same time, by narrating this as a personal revelation, von Foerster's story presents it as an ontological discovery, one manifest in a broad cultural shift in which 'the environment' became a matter of concern in popular culture and political life. In other words, the environmental thought as von Foerster relates it is a thought of the outside, in the sense described by Cary Wolfe (1998:xix) – referring "not to ecology in the usual sense nor to 'the Real' of psychoanalysis, but rather to one side of the system/environment distinction." The environment is a relative term, and its appearance as a problem within scientific inquiry and social life indexes an engagement with life on the basis of relationality.

[1] Von Foerster (1973), no page.

This dissertation traces the intrusion of the environment on economic thought and liberal governance in the formative period of neoliberal transition, roughly the late 1960s to 1989. By this I mean the way that the social and ecological conditions of production that had been excluded from economic analysis were brought in, in part through new ways of comprehending nature as capital. In other words, I aim to understand how the cultural shift evident in von Foerster's parable prompted changes in liberal governance, and gave rise to new ways of valuing and governing life in its relationality. Through a series of key moments in the modern history of the environment, I show that controversies around the definition and measure of nature's value present political problems through which definitions of the economy, the market, and their relation to the state are reworked and contested. At the same time, new ways of understanding and governing ecological dynamics have given rise to new strategies for the governance of life. In other words, I argue that the constitution of 'the environment' as an object of politics – and contestations over how this object should be conceptualized, managed, and valued – has been formative of neoliberalism as we know it.

In this way, the dissertation reevaluates the politics of the environment under neoliberalism, which has been a central preoccupation in geography for almost two decades. Within a now broad literature on 'neoliberal natures,' scholars have interrogated the implications of neoliberal policies for environmental governance, and analyzed the emergence of new environmental markets and new waves of resource privatization (Heynen and Robbins 2005; Heynen et al. 2007; Castree 2008a and b; Bakker 2010).[2]

[2] The title of this project echoes that of the 2007 book by Heynen, McCarthy, Prudham, and Robbins, entitled *Neoliberal environments: False promises and unnatural consequences.* As I

The environment, we are told, is a key site for the enactment of neoliberal reforms, through environmental de- and re-regulation in favor of unfettered markets (McCarthy and Prudham 2004; Castree 2008a); through new forms of enclosure that facilitate accumulation by dispossession (Mansfield 2007; McCarthy 2004); and through markets in novel environmental commodities such as ecosystem services and emissions offsets (Sullivan 2010; Robertson 2012; Boyd et al. 2011). In light of these developments, Neil Smith (2007:20) has argued that the neoliberal era has transformed our "core socio-economic relationship with nature."

As I explore further below, these critiques tend to portray a one-way process in which neoliberalism is something that is applied to environmental objects and problems, with predictably destructive consequences. In this way, they risk taking their objects (both neoliberalism and the environment) for granted. In contrast, this project demonstrates that the environment is not merely an external object to which neoliberal strategies have been applied, but a political problem (or interlinked set of problems) central to the history of the present.

Reevaluating the relationship between neoliberalism and the environment is important for two reasons. First, the genealogy of the environment reveals alternative histories of neoliberalism not as a coherent ideological program, but as a contingent and ongoing process of crisis-management. I draw on and extend the work of Paolo Virno (1996) to understand neoliberalism as a counterrevolutionary movement that works to redirect forces of social change toward the reinforcement of capitalist class power. This approach challenges 'capital-centric' portrayals of neoliberalism, while going beyond

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hope will become clear in the course of this introduction, the aim of this project is to rethink the nature of 'environment' as it is taken in that and related works. In that sense, the similarity is deliberate.

accounts of the geographical variegations of neoliberal natures (Bakker 2010). Instead, I advance a generative critique that locates the problem of nature's value as a point where the neoliberal project is particularly conflicted. In doing so, I challenge the humanist bias in Virno's approach to show how the refusal of nonhuman natures to conform to the demands of industrial production should be understood as a formative force in the counterrevolution. Second, this historical account expands the critical tools available for contending with environmental governance in the present. I draw out these implications in the dissertation's conclusion through a discussion of the contemporary politics of ecosystem services. I argue that when we expand our view beyond markets and commodification to examine the more-than-capitalist ways in which an *infrastructural nature* is produced and managed in the contemporary moment, we gain insight into the multiple logics and political rationalities at work in defining and contesting the value of nature in the present.

This introduction erects a theoretical framework for the following chapters by laying out the project's genealogical approach and its relation to a critique of value. I begin with a brief review of the literature on neoliberal natures, and argue for greater attention to the historical relation between neoliberalism and environmentalism in that literature. I also show how my approach indicates a different way of engaging with neoliberalism than that taken in the literature. Drawing on autonomist- and feminist-Marxist analyses, I suggest that what's 'new' about the developments addressed under the heading of neoliberal natures is not a unique investment in biophysical nature, but rather a historical transformation of the relation of capital to its social *and* ecological conditions. I then elaborate on the intersections between a genealogical approach (drawn from

Nietzsche and Foucault) and a Marxian critique of value, showing that the two share more methodological common ground than might be readily apparent. Reading Marx as a genealogist of capital, I argue, offers a *generative* orientation to the history and critique of neoliberal natures: that is, one that is not preoccupied with tracing the impacts of neoliberal policies on the ground, but with evaluating the forces at work within contemporary environmental governance that point beyond its neoliberal iterations. Finally, a chapter overview describes how this genealogy is elaborated through each chapter.

The nature of neoliberalism

Neoliberalism has, since the 1990s, become a pervasive idiom of critical scholarship and activism, to the point of exhaustion for some observers (Purcell 2016). If one can distill a common definition from the diverse efforts to theorize and document neoliberalism's iterations, it would center on the expansion of market relations into all domains of life – including politics, interpersonal relations, public services, and environmental governance, to name a few (Larner 2000; Springer et al. 2016). This process necessarily occurs in a variety of social domains, redefining the role of the state, transforming politics and policy, remaking bureaucracies, generating new institutional forms of knowledge production, and working through the micropolitical terrain of subject-formation (Larner 2000; Mudge 2008; Tyfield 2016; Read 2009; Anderson 2015). For the French regulation school, influential within economic geography, neoliberalism describes a new mode of social regulation associated with the transition to a post-Fordist regime of accumulation, associated broadly with flexible production systems, the predominance of financial and service sectors in the economy, and the 'feminization' of

labor (see Amin 1994). In other words, neoliberalism is associated with both a process of political-economic restructuring signaled chiefly by the increased precarity of labor and the financialization of the economy, and also a thoroughgoing transformation of social life in a way that privileges market rationalities and advances capitalist class power. Geographers in particular have emphasized the geographically- and historically-contingent path-dependencies of this process, shifting attention away from neoliberalism as an overarching program to 'neoliberalization' as an ongoing process (Peck and Tickell 2002; Brenner and Theodore 2002; Castree 2008a and b; Springer et al. 2016).

Within geography and related disciplines, a key focus of research has been the implications of neoliberalism for environmental governance, to the extent that the critique of environmental governance in recent years has been dominated by the analysis of 'neoliberal natures.' The rise of neoliberal policy in other areas of the economy, this literature describes, coincides with the widespread privatization and marketization of environmental resources; de- and re-regulation to facilitate the former; the expansion of market logics and "proxies" in the public sector; and the offloading of state responsibilities for environmental conservation to civil society groups (Castree 2008a:142; Collard et al. 2016). Critical scholars have parsed the empirical differences among these processes, and distinguished the environmental *impacts* of neoliberal policies (such as environmental deregulation) from neoliberal *environmentalism*: that is, new business and policy initiatives that aim to mobilize market forces for the explicit purpose of conservation (McAfee 1999; Castree 2008b; Büscher et al. 2012, Fletcher et al. 2014). It is within neoliberal environmentalism that some of the most novel scientific

and policy innovations around nature's valuation and management are taking place, and which will be my focus in this project.

In this literature, neoliberalism is addressed primarily as a set of policy reforms that advance strong property rights and the promotion of market relations as the most efficient and effective way of catalyzing investment in conservation. Geographers have traced the processes of abstraction, commodification, and marketization involved in efforts to make new natures conform to market logics, and have detailed the contradictions and conflicts that arise in this process (Robertson 2007; Bumpus 2011; Lansing 2011). At the same time, scholars such as Morgan Robertson (2006, 2012) have pointed out that these reforms depend on new scientific practices that enable nature to be abstracted as measurable, fungible units. In particular, the rise of 'ecosystem services' as a new paradigm of environmental governance has been cited as a defining feature of neoliberal natures: within the framework of ecosystem services, nature's value is increasingly measured in terms of the dynamic capacities of ecosystems to perform certain functions – such as carbon sequestration, flood mitigation, or water provision – while even the aesthetic or spiritual significance of nature is considered a 'service' whose economic value can be measured and accounted for in public policy and private investment (see Chapter 1). Sian Sullivan (2010) has portrayed ecosystem services as a "new imperial ecology," linked to the financialization of nature through new practices of "nature banking" and the securitization of environmental credits (also Sullivan 2013; Robertson 2012). As Jessica Dempsey and Morgan Robertson (2012:2) write, with the rise of ecosystem services "[n]ature is now found frequently represented as *credits*, *information*, or *services*, purportedly unbound from material essences and free to move

through global circuits of credit and finance commodities." But new economic metrics do more than just serve new markets: as Jessica Dempsey (2016) has pointed out in her recent book *Enterprising Nature*, the use of economic valuation to inform environmental policy through, for instance, cost-benefit analysis creates a situation in which various forms of nature (whether particular species, ecosystems, etc.) must prove their economic worth in order to merit conservation. This echoes what Michel Foucault describes as a "permanent economic tribunal" for life under neoliberalism, in which the market becomes the privileged technology for determining which lives will be fostered and which will be left to die, or actively extinguished (Dempsey 2016).

As many commentators have noted, the case-study based approach that dominates the literature lends itself to an understanding of neoliberalism as a geographically-variegated process that is riddled with contradictions and contingencies (Castree 2008a; Bakker 2010). Nowhere does this process look the same, or take on the character of an over-arching hegemonic program (for this reason scholars often use the language of 'neoliberalization' rather than 'neoliberalism'). Nevertheless, the sense is that neoliberal natures share a number of common features – chiefly defined by market logics and commodification – such that we can know neoliberal natures when we see them.
All this raises the question of what exactly we talk about when we talk about the environment under neoliberalism, and what unites these diverse developments as uniquely invested in the transformation of nature. This in itself has been a key question in the literature: as Bakker (2010:717) writes, "studies in this vein have tended to focus on the encroachment of capitalist economic relations on what we conventionally delimit as 'the environment' and 'resources', which are usually (albeit implicitly) defined as non-

humans." For Bakker, this leads to an under-appreciation of nonhuman agency in not only resisting capitalist enclosures, but also in generating new forms of socio-economic life (also Braun 2008). We can also draw two further observations from Bakker's statement: first, as mentioned above, this literature tends to presume a unidirectional relation between neoliberalism and nature, in which neoliberal policies are *applied to* environmental problems. This stems directly from the tendency to engage neoliberalism chiefly as a set of policy reforms. Second, and related, it tends to engage the environment as a set of material resources, or as a general term for nonhuman nature. In other words, a certain kind of critique characterizes the literature on neoliberal natures: having identified the defining features of neoliberal governance, it then charts the ways that these are enacted on the environment.

There are a few consequences of this: first, while focusing (quite rightly) on the social and ecological *impacts* of neoliberal policies and market rationalities, the literature has given less attention to how neoliberal technologies of governance *themselves* are forged through contestation over environmental issues. Second, the strong focus on commodification and markets risks constraining the field of analysis to those phenomena that are recognizably 'neoliberal,' while at the same time taking for granted their political implications. For instance, the understanding of ecosystem services as a "new imperial ecology" (Sullivan 2010) forged in alliance with market logics seems ill-equipped to comprehend the "hybrid" approaches to Payments for Ecosystem Services that deliberately depart from market models and are oriented around more-than-capitalist norms of valuation and exchange (e.g. Shapiro-Garza 2013, Kauffman and Martin 2014, Goldman-Benner et al. 2012). At the same time, the focus on markets and

commodification tends to downplay other crucial aspects of neoliberalism as a social formation, such as its productions of subjectivity. Where this is addressed, subject positions tend to be portrayed as the passive results of policy reforms, such as PES schemes that are seen to foster market-based values in place of other ethical orientations (e.g. Ezzine-de-Blas et al. 2015, Rode et al. 2015). In this way, the literature risks taking for granted the hegemony of market-based ideologies, rather than showing how that hegemony is necessarily constituted through resistance and struggle (see Larner 2000). One exception that deserves mention, although not directly situated within the 'neoliberal natures' canon, is work that charts the material underpinnings of neoliberal forms of life in the transformation of nonhuman natures. For instance Matt Huber (2013) has argued that the production of “entrepreneurial life” was made possible by the massive expansion of the oil complex and its extension throughout the fabric of everyday life. Alongside analyses that emphasize the "financialization of daily life" (Martin 2002), Huber shows that neoliberal subjectivities are also grounded in the more traditionally extractive economies of fossil fuel production. Jason Moore (2015) goes beyond energy resources to trace the material conditions of neoliberal restructuring in the global transformation of agricultural landscapes effected through the Green Revolution. In this way, Moore links human and nonhuman 'refusal' of capitalist social-ecological relations on a continuous terrain of class struggle (see also Chapter 1). These thinkers enhance our understanding of the more than human origins of neoliberalism by showing how it is premised on new forms of exploitation and expropriation that transcend what Moore (2015) terms the 'Nature/Society divide.' Their project differs however from my focus here: while I share their interest in neoliberalism's more-than-human origins, my focus is not primarily on

the environment as material resources, but on the environment as a political problem that has prompted changes in governance strategies and concepts of value. In other words, I use 'the environment' to name a political object that itself has a history – a history that I propose is concomitant with the rise of neoliberalism.

This suggests a different approach to the critique of both neoliberal natures and neoliberalism as they have been advanced in geography. Geographers have emphasized the path-dependent processes by which neoliberalism plays out in diverse contexts, but they have not generally applied this perspective to the *historical* analysis of neoliberalism: instead, geographical scholarship has mainly focused on the political economic origins of neoliberalism in the accumulation crises of the 1970s, which provided an opportunity for the advancement of neoliberal ideas already being formulated within elite circles (see Peck and Tickell 2002; Mirowski and Plehwe 2009; Harvey 2005). A related approach tends to focus on neoliberalism's intellectual histories in elite institutions like the Mont Pelerin Society (Mirowski and Plehwe 2009; Peck 2008), and the dissemination of these ideas through influential politicians like Ronald Regan and Margaret Thatcher. As Simon Springer, Kean Birch and Julie MacKeavy (2016:3) state, "The common theme among all of these accounts is an acceptance of a historical lineage to the development of neoliberalism, that it came from somewhere and that its trajectories were largely purposeful." One way of reading this is to say that while geographers have highlighted difference in the application of neoliberal ideas to diverse contexts, they have not attended to difference in the *origins* of neoliberalism.

This is especially true of the literature on neoliberal natures, dominated as it is by an approach to neoliberalism as a set of policy reforms. As Wendy Larner (2000:7)

commented with reference to this tendency in the broader literature on neoliberalism, in this approach "it is assumed that neoliberalism is a policy reform programme initiated and rationalized through a relatively coherent theoretical and Ideological framework," the capital "I" here intentionally referring to ideology as a deliberate political agenda. Along these lines nature's neoliberalization tends to be portrayed as the product of specific agendas formulated in elite institutions, which are then imposed on socio-ecologies with varying levels of success. In contrast I want to suggest that, if neoliberalism as it actually exists is characterized by a hybridity of logics (McCarthy 2005), this is not only a product of its path-dependent unfolding but was constitutive of neoliberal governance from the beginning. As Mudge (2016:98) writes, "What scholars call 'neoliberalism' is a cumulative effect of a whole series of struggles in settings in which the MPS [Mont Pelerin Society] is unknown, free markets are not at issue, and the category 'neoliberal' is meaningless… How do we analyse neoliberalism, absent *neoliberals*?"

In this dissertation, I use the terms *neoliberalism* and *neoliberal environmentalism* to denote not a political ideology that seeks to remake the world in its own image (cf. Mirowski and Plehwe 2009), but rather a historical formation characterized by the strategic containment of social change toward expanding market rule and reestablishing capitalist class power (Povinelli, in Coleman and Yusoff 2014; Braun 2015a). As I elaborate further in Chapter 1, my approach builds on Paolo Virno's (1996) analysis of neoliberalism as a counterrevolutionary movement. For Virno, neoliberal 'innovations' were not so much rational solutions to problems of accumulation, but the reappropriation of resistance toward the reinstatement of capitalist class power: "The masterpiece of the Italian counterrevolution," Virno (1996:241) writes, "was its having transformed those

collective tendencies, which in the movement of ’77 were manifested as intransigent antagonism, into professional prerequisites, ingredients of the production of surplus value, and leavening for a new cycle of capitalist development.” In other words, the defining features of neoliberal capitalism – a devolution of governance structures; flexible and adaptive forms of labor management; the centrality of forms of labor formerly relegated to the unwaged sphere of social reproduction – were developed through the cooptation and inversion of workers’, students’, and women’s self-organization in the context of these struggles.

In this understanding, neoliberalism operates on a number of levels – ideological, economic, governmental, political, interpersonal, geopolitical, academic, and cultural, to name a few – to capitalize on disruptive tendencies in ways that have discernable and (sometimes) deliberate class effects. Like Harvey (2005), this definition emphasizes the class dimensions of neoliberalism; but rather than focusing on the top-down exercise of capitalist class power, it highlights the way that neoliberalism is constituted through struggle among competing social forces and values. Neoliberalism is not a pre-determined program imposed with varying levels of success, but a series of effects produced through contestation; as such it is fundamentally 'hybrid.' In this definition, neoliberal political and economic theory is a significant force among many others in shaping neoliberal realities, moving through various institutional channels to become a kind of market fundamentalist faith; but it does not in itself define neoliberalism as a historical phenomenon.

I this light, I engage neoliberal environmentalism not as a set of policy reforms, but as an ensemble of scientific practices, regulatory reforms, legal decisions and

legislation, ethical propositions, and technological innovations that together work to redirect environmental values toward the reproduction of capitalist social relations. In this sense it can be understood as an apparatus of government in Foucault's sense, which draws together a "thoroughly heterogeneous set" of elements in response to an "urgency" (quoted in Braun 2014:51). Importantly, the 'fit' of these elements together is never guaranteed; they retain political lives and genealogies that exceed their function within the apparatus, and which continually shape the latter's trajectories and tendencies (Braun 2014). Thus while an apparatus is drawn together, in a moment of necessity, from pre-existing elements in line with a particular strategic orientation, it displays no determining 'logic'. Combining this with Virno's approach highlights neoliberal environmentalism as a reactive formation that is shot through with contestation over environmental values, and the relation between life and work. At stake in this approach is a new style of critique: rather than pointing out the destructive effects of neoliberal realities, it is a matter of mapping the play of forces that gave rise to contemporary forms of domination, with the aim of unearthing the subversive potentials within them. In Virno's (1996:243) words, it is a matter of writing a "future history," or "the *remembrance* of the potential class struggles that may take place in *the next phase*."

It is in this reorientation of critique, as I describe below, that a counterrevolutionary understanding of neoliberal environmentalism lends itself to a genealogical method. Whereas Virno focuses on the new social forces emerging through revolutionary struggle in 1970s Italy, I aim to understand the place of environmental politics in the counterrevolutionary turn. How might we see contemporary forms of ecosystem services and natural capital as the product of a struggle among competing

values? How is it that the forms of market rule and rationality that define the neoliberal present were shaped, at least in part, by confrontation over the nature and definition of 'environmental' problems? As I describe below, a genealogical approach prompts us to reevaluate the history of the present in light of its heterogeneity and contingency. Rather than documenting the impacts of neoliberal policies, this approach strives to show that contemporary stories about neoliberal nature may "have more than one ending" (Peluso 2012:100).

Genealogy, critique, and the value of environmental values

You see, what I want to do is not the history of solutions… I would like to do the genealogy of problems, of problématiques*. My point is not that everything is bad, but that everything is dangerous, which is not exactly the same as bad. If everything is dangerous, then we always have something to do. So my position leads not to apathy but to a hyper- and pessimistic activism.*

– Foucault, On the Genealogy of Ethics[3]

Genealogies, as distinct from histories, problematize the present. That is, they take as their object problems, "[b]ut not just any problems" (Koopman 2013:1). That genealogies problematize the present means that they interrogate those problems that constitute the conditions of our existence, that are not even visible as problems but are taken to be beyond history: sexuality, morals, ethics (Foucault 1990; Nietzsche 1887/2000; Rabinow, Dreyfus and Foucault 1984). The environment, this dissertation proposes, constitutes just such a problem. Our contemporary understanding of the global environment — as a complex system with immense but finite adaptive capacities, characterized by both a finitude of resources and an excessive volatility, whose dynamics

[3] In Rabinow, Dreyfus and Foucault 1984:343

underpin our lives even as they defy our understanding — appears to have an obvious reality, to be self-evident in the contemporary experience of resource scarcity and climate upheaval. But this understanding has a specific history. Moreover, an interrogation of the environment as a problem opens onto histories of the present beyond environmental thought and management. In other words, the genealogy of the environment simultaneously offers an alternative genealogy of neoliberalism.

For Nietzsche, as Gilles Deleuze (2006) has argued, the genealogical method is an inquiry in to the *value* of values. Nietzsche summarizes his central question in the *Genealogy of Morals* thus:

> under what conditions did man devise these value judgments good and evil? *and what value do they themselves possess?* Have they hitherto hindered or furthered human prosperity? Are they a sign of distress, of impoverishment, of the degeneration of life? Or is there revealed in them, on the contrary, the plenitude, force, and will of life, its courage, certainty, future? (Nietzsche 2000a, 453).

For Nietzsche, the origin is the locus of a hierarchical encounter, through which one force grows greater through the appropriation and subjugation of another.[4] This understanding of the origin entails an absolute rejection of the transcendent 'good,' the valuable-in-itself, and insists that all value judgments – *evaluations* – are the outcome of a fundamental struggle; they are the assessments of dominating and subjugated forces in relation to one another. In his critique of Paul Ree's explanation of morality in terms of a rational calculus of utility, Nietzsche writes:

[4] Foucault notes Nietzsche's use of the noun *Entstehung* (emergence) as opposed to *Ursprung* (origin) to describe this play of forces: "The analysis of the *Enstehung* must delineate this interaction, the struggle these forces wage against each other or against adverse circumstances, and the attempt to avoid degeneration and regain strength by dividing these forces against themselves" (Foucault 1984:83-84).

purposes and utilities are only *signs* that a will to power has become master of something less powerful and imposed on it the character of a function; and the entire history of a 'thing,' an organ, a custom can in this way be a continuous sign-chain of ever new interpretations and adaptations whose causes do not even have to be related to one another but, on the contrary, in some cases succeed and alternate with one another in a purely chance fashion" (Nietzsche 2000:513).

The first point to be made about genealogy is therefore its insistence on the contingency and non-linearity of the process by which present forms of life have come to cohere. This means that the origin of a thing does not imbue it with an essential meaning or purpose; present forms do not carry their origin with them as a kind of essence,[5] such that the political implications of a given thing could be known in advance by virtue of tracing its history. Rather, "the cause of the origin of a thing and its eventual utility, its actual employment and place in a system of purposes, lie worlds apart" (Nietzsche 1887/2000:513). Genealogy thus describes a materialist history, not in the sense of a crude empiricism or a catalog of 'facts', but a project of deciphering this 'sign-chain' of material encounters, appropriations, and reinterpretations. The pattern and direction of this process are arbitrary in the sense that they do not proceed toward a goal but are the result of a series of contingent encounters, "a succession of more or less profound, more or less mutually independent processes of subduing, plus the resistances they encounter, the attempts at transformation for the purpose of defense and reaction, and the results of successful counteractions" (Nietzsche 1887/2000:514).

Genealogy demands a "long, brave, industrious, and subterranean seriousness", it demands 'going under' into existing forms to discover in them *bridges*, intimations of a higher form. The reward of this seriousness with regard to existing values is that "some

[5] As Deleuze writes, however, Nietzsche does have a concept of essence that suggests that the thing itself is not perfectly neutral: if the sense of a thing is determined by the force(s) that appropriate it, "Essence… will be defined as that one, among all the senses of a thing, which gives it the force with which it has the most affinity" (Deleuze 2006:4).

day one will perhaps be allowed to take them *cheerfully*" (Nietzsche 1887/2000:457): to take "our old morality" lightly would be to discover what in it points toward its overcoming, and thereby to posit a new interpretation, to impose on it the character of a means to an end that is not its own. The problem of the value of values thus rejects the possibility of a disinterested critique, and is, at its basis, a political engagement:

> the question: what is the *value* of this or that table of values and 'morals'? should be viewed from the most divers perspectives; for the problem of 'value *for what?*' cannot be examined too subtly. Something, for example, that possessed obvious value in relation to the longest possible survival of a race (or to the enhancement of its power of adaptation to a particular climate or to the preservation of the greatest number) would by no means possess the same type of value if it were a question, for instance, of producing a stronger type. The well-being of the majority and the well-being of the few are opposite viewpoints of value: to consider the former *a priori* of higher value may be left to the naiveté of English biologists. – *All* the sciences have from now on to prepare the way for the future task of philosophers: this task understood as the solution of the *problem of values*, the determination of the *order of rank among values"* (Nietzsche 1887/2000:491-492, original emphasis).

Nietzsche thus argues that the philosopher, in order to mount a true critique of values, must become a genealogist. This is also, in an important sense, Marx's method in developing a materialist critique of capitalist value. Marx asks: how does the specifically capitalist system of value come to be, and how does it come to dominate other modes of valuation? Further, in what way does capitalism constitute an advance; what forces become stronger through it, and seek its overcoming?

In order to map this methodological common ground, we can take a brief detour into Marx's concept of *Ursprüngliche akkumulation*. Generally translated as primitive or original accumulation, this term refers to the "historical genesis" of capitalism, whereby "capital comes [into the world] dripping from head to toe, from every pore, with blood and dirt" (1867/1990:927, 926). Marx's account of this original accumulation is aimed against the "insipid childishness" of the bourgeois political economists, whose apologetic

defense of private property leads them to account for the origins of capital "from the standpoint of the nursery tale" (1867/1990:874), a morality story whereby the value-structures of capitalism pre-exist its historical emergence and are given the status of a cause:

> Long ago, there were two sorts of people; one, the diligent, intelligent and above all frugal elite; the other, lazy rascals, spending their substance, and more, in riotous living… Thus it came to pass that the former sort accumulated wealth, and the latter sort finally had nothing to sell but their own skins (1867/1990:873).

"In actual history," Marx assures us, "it is a notorious fact that conquest, enslavement, robbery, murder, in short, force, plays the greatest part" (874). This is true not only of the origins of capital, but of history in general. In *The German Ideology*, Marx and Engels (1932/2000:181) offer a concept of history as the "production of material life," the development of the productive forces of humankind through social cooperation and the appropriation of nature as the means of production. The movement of history as they describe it is the development of new social forms and productive capacities through the appropriation of existing material, demanding a historical method capable of comprehending the chain of appropriations, reworkings, and reinterpretations through which a 'thing' comes to have a meaning and a purpose. It is through labor – the practical activity of appropriation and interpretation – that new needs, capacities, and forms of life are produced. It is thus not in the sense of a crude economism that they argue "that the multitude of productive forces accessible to men determines the nature of society, hence, that the 'history of humanity' must always be studied and treated in relation to the history of industry and exchange" (Marx and Engels 1932/2000:183), but from the perspective of an expanded notion of production as the creative activity of life itself.

Marx addresses the origin (*Ursprung*) of capital with the same emphasis on the growth of forces in struggle that Nietzsche brings to the genealogy of morals. There is no supreme economic logic smoothly organizing productive capacities in the interest of accumulation; there is no calculus of utility determining the course of events. Rather, we have a violent eruption of productive forces that, developing within the structures of feudal society itself, find themselves constrained by these structures and seek to overcome them: "the rise of the industrial capitalists appears as the fruit of a victorious struggle both against feudal power and its disgusting prerogatives, and against the guilds, and the fetters by which the latter restricted the free development of production and the free exploitation of man by man" (Marx 1867/1990:875). The structures of feudal society create the conditions for their own destruction, as "new forces and new passions spring up from the bosom of society, forces and passions which feel themselves to be fettered by that society. It [feudal society] has to be annihilated; it is annihilated" (928). While condemning their expropriation, Marx is not nostalgic for the feudal commons: to recover them would be to "decree universal mediocrity" (928, quoting Pecqueur). This account of capital's origins posits the creativity of labor-power as the motive force of historical development: it is the will to self-expansion of human productive capacities that institutes the double freedom of wage labor, and thus ushers in a new regime of exploitation. Marx's phrase might thus be better translated *originary* accumulation, to emphasize the movement – both violent and creative – through which capitalist value comes to be dominant.

The central problem, for Marx, is how the specifically capitalist form of value comes into being through concrete social relations of production characterized by private

property and wage labor, and how it comes to determine the development of human productive capacities. Here, Marx and Nietzsche share an ironic invocation of the term *Ursprung*: for Nietzsche, the term (as opposed to close synonyms such as *Enstehung, Herkunft* or *Anfang*) is often used (in its stressed form) to refer to a singular origin, the search for a transhistorical identity that Nietzsche rejects in Paul Ree (Foucault 1984:77).When it is invoked in an ironic register, however, it highlights the low-minded or "detestable" origins of morality in reactive affects (77). Marx's dismissal of the "so-called primitive accumulation" of the bourgeois economists takes a similar ironic tone: in place of their moralistic origin story, which "plays approximately the same role in political economy as original sin does in theology,"[6] Marx describes a process that is both violent and ongoing, a subterranean struggle that "runs through its [capitalism's] various phases in different orders of succession, and at different historical epochs" (Marx 1990:873, 876).

If Nietzsche's genealogy of morals aims to account for the triumph of the reactive morality of German Protestant culture — how is it that "slave morality," or the morality of *ressentiment*, has acquired the right to assert values? — Marx aims to account for the triumph of capital as a reactive mode of valuation, one that ultimately stifles human creative forces, and to diagnose the conflicted figure (the proletariat) capable of overcoming this regime of value and in doing so overcoming itself.[7] For instance, in the *Economic and Philosophic Manuscripts of 1844*, Marx is at pains to demonstrate how

[6] As Marx writes sarcastically: "Its origin [*Ursprung*] is supposed to be explained when it is told as an anecdote about the past" (Marx 1990:873).

[7] There is in this way an unexpected resemblance between Nietzsche's figure of Zarathustra — the transitional figure between the human and superhuman (*Übermensch*), who points beyond himself to desire his own overcoming — and Marx's understanding of the proletariat as that subject who abolishes the very conditions that produce it as a coherent subject, as the 'working class.'

both the institution of private property and the position of the capitalist himself are the product of the worker's concrete activity, such that throughout his analysis, labor (as the fundamental activity of life) remains primary as the active force guiding social development, whereas capital itself is a *product,* rather than the cause, of estranged labor. The worker is thus the site of a conflict, in which his own capacity for self-affirmation and growth is turned into a means for his mere persistence, as estranged labor reverses the relation of the individual to humankind in general by making "*life of the species* into a means of individual life" (Marx 1844/1959:31). This introduces a tension into Marx's conception of value which, as Harvey writes, persists throughout *Capital*:

> The *discipline* imposed by commodity exchange… contrasts with the activity of human labor as the 'living form-giving fire,' as the 'transitoriness of things, their temporality,' and as the free expression of human activity… Value theory deals with the concatenation of forces and constraints that discipline labor as if they are an externally imposed necessity. But it does so in the clear recognition that in the final analysis labor produces and reproduces the conditions of its own domination (quoted in Henderson 2004:451).

As Henderson argues, this tension between value as a fixity of relations and value as a "multifaceted disciplining process whose closures (fixities) are not exactly guaranteed" (453) remains unresolved in Harvey's analysis. Instead, Harvey posits a series of epicyclical solutions for contending with difference, "heap[ing] layer upon layer of social contingency onto the notion of value, pressing it to the breaking point, yet disallowing the breakthrough to another reworking" (459). Henderson proposes that this tension may be better conceptualized as a constitutive antagonism at the heart of value itself. Thus it is not only that capital's subsumption of other value-relations is always incomplete, but that this incompleteness is "'socially necessary' for, but not grounded in value" (Henderson 2004:459).

Vinay Gidwani (2008) pursues a similar interpretation of value in his reading of the *Grundrisse*. Gidwani revisits Marx's famous passages on living labor from the Chapter on Capital, in which Marx considers "the not-*objectified*, hence non-objective, i.e. subjective existence of labor itself. Labor not as an object, but as activity; not as itself value, but as the living source of value." In this guise, labor is the "contradictory being" of capital, naming at the same time a pure potentiality that is the general possibility of wealth, and "absolute poverty," or the deprivation of the conditions of its own actualization (quoted in Gidwani 2008:870). Value then inheres in the *relation* between labor-power as potentiality (both for capital and for itself) and capital as an apparatus of capture that, in actualizing labor-power as capital, must continually foreclose other possible actualizations.[8]

What emerges from these discussions is an understanding of capitalist value not as an overarching logic which, while internally coherent, subsequently encounters other logics in opposition to it, but as itself a historically-shifting play of forces, an ongoing process of domination and reorientation of other possible valuations.[9] This has important implications for the critique of value. As Negri (1996:151) writes, there is a risk within historical materialism of "illustrating the form of value in the progressive, albeit utopian, deterministic process of perfecting its mechanisms" (Negri 1996:151)." Instead, this reading suggests that capital is always immanent to (and therefore both capacitated and constrained by) its historically-specific apparatuses of capture. As Gidwani (2008:870) writes, capitalism has a "virtual materiality," describing "no more *and* no less than the

[8] Similarly, Negri (1996:150) writes that the form of value is at once the "material representation" of the antagonistic relations of production and their obfuscation through the appearance of equivalence.
[9] See also De Angelis 2006.

combinatorial effect of spatially diffuse and iterative practices that enable the capture of labor's use-value for the production of surplus." We are confronted with an understanding of value's 'origin' that looks very much like Nietzsche's process of *subduing* that underlies every valuation. This indicates that we might consider the origin not an event that is localizable in a chronology, but rather an ongoing and always-incomplete process of domination. Furthermore, in this view capital is posited as a *reactive* force, and labor-power is given ontological primacy.[10] At the same time, this reading carries us beyond the relation between capital and labor-power to posit an understanding of value as necessarily in relation to an outside, a "noisy sphere" (Henderson 2004:459) of social relations and materials that necessarily exceed capital.

Marx's description of primitive accumulation, I propose, could be read as a *genealogical* account of capital, and his critique of political economy as an *evaluation* of capitalist value. This, Marx himself asserts, distinguishes it from classical political economy:

> Political economy has indeed analysed value and its magnitude, however incompletely, and has uncovered the content concealed within these forms. But it has never once asked the question why this content has assumed that particular form, that is to say, why labor is expressed in value, and why the measurement of labor by its duration is expressed in the magnitude of the value of the product. These formulas, which bear the unmistakable stamp of belonging to a social formation in which the process of production has mastery over man, instead of the opposite, appear to the political economists' bourgeois consciousness to be as much a self-evident and nature-imposed necessity as productive labor itself (Marx 1867/1990:173-175; quoted also in Elson 1979:123-124).

Reading Marx as a genealogist, we might say that his critique involves both a problematization and an evaluation of capitalist value: one the one hand, he interrogates

[10] This reading is consistent with Mario Tronti's (1965/2007:31) assertion that the true 'gift' of the worker to capital is not labor, but capital itself: "If the conditions of capital are in the hands of the workers… then one can conclude that the capitalist class, from its birth, is in fact subordinate to the working class… Exploitation is born, historically, from the necessity for capital to escape from its *de facto* subordination to the class of worker-producers."

how the capitalist form of value has come to be and how it has come to dominate other value forms, problematizing value's "self-evident and nature-imposed necessity." Going one step further, however, he *evaluates* the consequences of this domination for human development and species-being[11] – or as Diane Elson (1979:123) has put it, he asks "what the political consequences are." This evaluation is not a moral judgment but an inquiry into the *value* of capitalist value, the play of action and reaction among forces that are manifest in the form of value in capitalism. As Deleuze (2006:8) argues, this task of evaluation is what defines genealogy:

> [W]e can note the progression from sense to value, from interpretation to evaluation as tasks for genealogy. The sense of something is its relation to the force which takes possession of it, the value of something is the hierarchy of forces which are expressed in it as a complex phenomenon.

In this light we could ask: what is the *value* of natural capital or ecosystem services, and mean something very different from what environmental economists may mean when they ask this question. In other words, how do we advance a critique of neoliberal environmentalism capable of addressing the "hierarchy of forces" expressed in it?[12] Evaluation is in this way a political project, insofar as it involves uncovering those forces at work in capitalism that point beyond it. On this basis Marx, like Nietzsche, criticized the "crude communism" of Proudhon and other socialists in his early writings:

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[11] In the Economic and Philosophic Manuscripts, Marx (1844/1959:31) writes that "The whole character of a species, its species-character, is contained in the character of its life activity; and free, conscious activity is man's species-character." Hence species-being refers to humanity's collective capacity to change the conditions of its existence, a capacity that is alienated in capitalism. For a discussion, see Dyer-Witheford 2004.

[12] This evaluative function of genealogy accords with what Negri (1996:150) describes as the critique of labor, whereby the analysis of labor becomes "critique proper": "And where the analysis of labor shows that the development of social labor produces either a process of accumulation of value or a complex of norms of distribution, the critique of labor breaks this synthesis, unhinges this constitution and marks the singularity of the dynamism of the antagonisms which the form of value comprehends."

whereas crude communism would negate the individual by instituting an artificial equivalence as the practical basis of political life, and thus realize "the logical expression of private property, which is this negation" (Marx 1844/1959:42), communism for Marx describes "the real *appropriation* of the *human* essence by and for man; …the complete return of man to himself as a *social* (i.e., human) being – a return accomplished consciously and embracing the entire wealth of previous development" (43). In Nietzche's terms, then, we might say that communism involves a transvaluation of values.

The function of evaluation leads directly to what Colin Koopman (2013) describes as the *transformative* effect of genealogy.[13] Koopman places Foucault's genealogy in the tradition of Kantian critique. If Kant posed critique as a "determination of the limits of our thought on the basis of an inquiry into the conditions of possibility of that thought itself" (Koopman 2013:15), he held these conditions to be given a priori, and therefore the limits of thought to be transcendent and universal. Foucault, Koopman argues, transposes this notion of critique into a historical register; the conditions of possibility for thought are historical rather than universal, and its limits historically contingent rather than transcendent. While Koopman does not make this parallel (and indeed would seem opposed to any effort to map the affinities between Marx and Foucault), this inversion of Kant parallels that performed by Marx on Hegel, whereby

[13] Koopman differentiates Foucault's genealogy from that of Nietzsche on the basis of this notion of evaluation. While Koopman I think misreads Nietzsche's mode of evaluation as a kind of judgment, he is right is pointing to this distinction insofar as Foucault seems to place less emphasis on the evaluative dimension of genealogy (a dimension that Deleuze (2006) brings out strongly). Within Deleuze's (2006) reading of Nietzsche, this transformative function is contained within the process of evaluation, insofar as the latter involves the assertion of new values, or a transvaluation.

Marx recast the dialectic in a materialist register and thereby stood Hegel back on his feet (See Marx 1867/1990:103).

In bringing Kantian critique down to earth, Koopman argues, genealogy charts the limits to thought in such a manner that these become objects of experimentation rather than immutable boundaries. Critique, he writes, is "etymologically linked" to crisis and to cutting, to locating the critical divisions that "define the limits of our thought" (Koopman 2013:15). Or, as Foucault puts it in his reflection on the genealogical method, "effective" history is that which separates us from ourselves, "introduces discontinuity into our very being," and destabilizes the taken-for-granted foundations of the self. "This is because knowledge is not made for understanding; it is made for cutting" (Foucault 1984:88).

In a genealogical mode, critique is a *transformative* practice that pushes beyond the limits to the self: "The critique of what we are is at one and the same time the historical analysis of the limits imposed on us and an experiment with the possibility of going beyond them" (Foucault, quoted in Koopman 2013:16). This refers to what Foucault describes as the sacrificial use of history, which reveals the will to knowledge to be a kind of violence, a "malicious" disruption of established forms and identities, "something murderous, opposed to the happiness of mankind" (Foucault 1984:95). Returning to Nietzsche's formulation, the will to knowledge describes a radical break in the self by which forces within it strive to overcome its present identity and point toward a new formation ("I love him who wants to create over and beyond himself and thus perishes" [Nietzsche 1883/1982:177]). The subject of knowledge is therefore one with a

suicidal instinct[14]. In this way, as Deleuze (2006:1) writes, for Nietzsche "the philosophy of values as envisaged and established by him is the true realization of critique and the only way in which a total critique may be realized, the only way to 'philosophize with a hammer'." We can also draw a continuity between Niezsche's hammer and Marx's invocation of a transformative critique in his admonition that "philosophers have only interpreted the world, in various ways; the point is to change it" (Marx 2000:172).

This notion of critique as the transformation of limits has particular implications for an environmental project, in at least two ways. First, if critique in its genealogical mode denotes an inquiry into the historical conditions that provide both the possibility for and the limits to our current ways of being (Koopman 2013:17), then its task is, at a fundamental level, to contend with the nonhuman milieu through which that history unfolds, including and especially our historically shifting understanding of our relation with that milieu. For instance Foucault (1984:84) draws on Nietzsche's biological metaphors to describe the notion of the origin as *Enstehung*, or emergence:

> …the emergence of a species (animal or human) and its solidification are secured 'in an extended battle against conditions which are essentially and constantly unfavorable.' In fact, 'the species must realize itself as a species, as something — characterized by the durability, uniformity, and simplicity of its form — which can prevail in the perpetual struggle against outsiders or in the uprising of those it oppresses from within.'

The analysis of the origin is therefore an inquiry into the relation between a thing and its environment, or milieu (and we can see immediately how historical understandings of this relation have shaped the concept of genealogy itself). Second, insofar as the nonhuman environment has since the late 20th century been formulated primarily *as* limits, that is, as immutable constraints upon human existence and politics,

[14] "This does not mean, in terms of a critical procedure, that the will to truth is limited by the intrinsic finitude of cognition, but that it loses all sense of limitations and all claim to truth in its unavoidable sacrifice of the subject of knowledge" (Foucault 1984:96).

then a critique of environmental limits would appear essential. How is it that our understanding of the environment as both condition and constraint has taken shape? What are the material and historical conditions of possibility that gave rise to this formation, what are the forces at work within it, and how might they problematize its taken-for-granted objectivity in the present?

Situating these questions within the parameters of the current project, this dissertation takes a genealogical approach in order to do three things: 1) to *problematize* neoliberal environmentalism, in the sense of drawing out its contingency and the heterogeneity of its logics against its depiction as self-evident or unified (including those narratives that find its origin in a singular logic of capital); 2) to *evaluate* the conditions of its emergence, the forces at work within it, and the relations of domination and subjection that animate it; and 3) to indicate the *transformative* potential of those forces insofar as they point beyond the real subsumption of the biosphere and toward other possible futures.

Chapter Overview

The attention to contingency, as Foucault writes, asserts an "indispensable restraint" on the genealogist: it binds her to "record the singularity of events outside of any monotonous finality;" to "be sensitive to their recurrence, not in order to trace the gradual curve of their evolution, but to isolate the different scenes where they were engaged in different roles;" even to chart those places where they failed to appear "(Plato, at Syracuse, did not become Mohammed)" (Foucault 1984:76). This restraint is certainly felt within the present project. There are many ways that the story of the environment in the neoliberal counterrevolution could be told, and my account does not aim to be

definitive or exhaustive. Instead, I have chosen to highlight moments that I feel constitute critical "events" in the relation between neoliberalism and the environment:

> An event… is not a decision, a treaty, a reign, or a battle, but the reversal of a relationship of forces, the usurpation of power, the appropriation of a vocabulary turned against those who had once used it, a feeble domination that poisons itself as it grows lax, the entry of a masked 'other' (Foucault 1984:88).

In other words I have tried to focus on events that, while they may seem tangential or even superfluous to the established institutional history of neoliberal environmentalism, are formative from a genealogical perspective. Some of these events are well-known landmarks in environmental politics — such as the *Limits to Growth* report, or the *Exxon Valdez* oil spill — that I revisit in order to highlight other forces at work in their history. They all are critical moments in the sense that they constitute a break or a bifurcation through which new interpretations become possible and may even take hold. The events I have chosen are by no means the only decisive points in this process. They are, however, ones that I feel bring to light significant lineages of neoliberal environmentalism that remain active in its present, revealing traces of its descent that attest to its heterogeneity (Foucault 1984:82).

The following chapters trace the emergence of key forms of knowledge and technologies of power that have come together to shape neoliberal environmentalism in the present, including concepts of natural capital, systems theory, global modeling, and environmental valuation methodologies. In the process, I show how the emergence of these environmental technologies was also generative of new forms of governance beyond the sphere of environmental problems, giving rise to new biopolitical technologies, new understandings of economic rationality, new class formations, and new financial strategies for contending with risk, among others. In other words, I investigate

how the politics of the environment have played a formative role in the neoliberal turn since its inception. This approach runs counter to a pervasive presentism in American geography, which tends to de-emphasize historical investigation in favor of fieldwork grounded in the present. Against this tendency, I aim to show that an investigation into the social and political history of the environment in the rise of neoliberalism is essential to understanding neoliberal environmentalism in the present — not, of course, to assert that the past "continues secretly to animate the present, having imposed a predetermined form on all its vicissitudes" (Foucault 1984:81), but in order to call attention to the play of forces that work through it. A genealogical perspective on neoliberal environmentalism thereby attests to the conflicted and contradictory nature of the neoliberal project in general, not as an overarching logic but as an ongoing and unresolved series of attempts at crisis-management.

While the chapters are organized in a roughly chronological order, they are not intended to be read as a sequential narrative. Instead, each traces a different thread running through the contemporary apparatus of neoliberal environmentalism, and charting a different course of environmental thought and politics through the counterrevolution. In this way each could be read as a standalone engagement with a particular element that will be formative of neoliberal environmentalism as it took shape or was transformed through a critical event in its history. The possible exception to this is Chapters 2 and 3, which together trace the evolution of systems thinking from a closed-system ontology of limits to the open, progressive dynamics of complex adaptive systems. In the process, however, each chapter also takes up other threads running through the project, including the changing posture of industry with regard to

environmental issues and the role of corporations in environmental governance, and the transformation of government into an art and science of 'management'. Together these chapters show how systems theory takes shape as a new ontology of nature and how it morphs in response to urgencies such as new social movements, labor militancy, and global-scale environmental problems.

I begin in Chapter 1 by exploring the emergence of the economic theory of natural capital and ecosystem services in the crisis of US hegemony in the 1960s and 1970s. My primary materials for this chapter include the early literature in environmental and ecological economics, alongside UN documents from the 1972 Conference on the Human Environment in Stockholm. Taking up Morgan Adamson's (2012; following Frederic Jameson) periodization of the short American century (1945-1973), I develop the concept of *environmental crisis* to describe how the crisis of Fordist-Keynesianism required new ways of accounting for and rationalizing both social and ecological reproduction. Drawing on the work of Marxist-Feminists such as Leopoldina Fortunati and Silvia Federici, I therefore use the term *environmental crisis* to refer not to problems confined to nonhuman ecosystems and populations, but to name a breakdown of the boundaries of 'the economy' as it had operated as a technology for the governance of social life in the mid-20th century (Mitchell 1998) – a breakdown that was signaled by the widespread recognition of the need to account differently for the activities of both social and ecological reproduction. With a focus on the fields of environmental and ecological economics, I show that the modern notion of ecosystem services contended with the related but distinct problems of how economics would be called to account for new values articulated by the environmental and countercultural movements, and for the

reproductive functions of biophysical systems left out of conventional economic analysis. I argue that in this light the neoliberal transition involved a transformation of the relation between capital and its outside, which includes the reproductive capacities of both humans and nonhumans. This shift, I suggest, is indexed by an *infrastructural* concept of nature that emerged in early notions of ecosystem services, and I show how this concept became a matter of geopolitical concern in and around the UN Conference on the Human Environment in 1972. I argue that at stake in the modern notion of ecosystem services is how and by whom the work of socio-ecological reproduction will be valorized, a perspective that offers a new approach to the critique of ecosystem services in the present. This chapter sets the stage for subsequent chapters by theorizing the environmental crisis as the conjuncture that gave rise new ways of valuing and governing environmental processes (in the broadest sense of the term).

Building on this conceptual and historical framework, the second chapter focuses on a seminal articulation of environmental crisis, the landmark report on *The Limits to Growth* published by the Club of Rome in 1972. The vision of impending global crisis through an imminent encounter with environmental limits that the report articulated would come to inform a whole era of environmental thought structured around a politics of scarcity. Focusing on the career of Aurelio Peccei, the founder of the Club of Rome and a top manager at Fiat in charge of globalizing its manufacturing operations, I show how the vision of the earth as a closed equilibrium system on the verge of collapse was indelibly shaped by the crisis of US economic hegemony and the anxieties of globalizing multinational capital. More importantly, however, by approaching the project through Peccei's career, I illuminate an alternative political history of the *Limits* report not

acknowledged in existing histories of the project: Peccei's career in Argentina and Italy put him at the center of an increasingly volatile alliance between militant labor and New Left movements that disrupted the collusion between union and management bureaucracy upon which Fordist-Keynesianism had depended, and signaled the death of the social democratic vision of a solution to the crisis. The international alliance between labor and the New Left was a counterforce undercutting the emerging vision of globality that would be articulated in the *Limits* report, such that environmental crisis appeared as a crisis of management of the global system. *Limits* can therefore be read as the product of a contestation over the kind of globalism that would define the post-Fordist era, and the political uses to which notions of environmental commons and limits would be put. To further illustrate this, the final section of the chapter examines the geopolitical context in which *Limits* gained meaning, highlighting an alternative Latin American World Model published by the Bariloche Institute in Argentina, which demonstrated that environmental crisis could only be addressed through transition to an egalitarian socialism. This chapter not only provides a counter-narrative to histories of global modeling focused on its military origins, but also augments the Autonomist periodization of crisis and counterrevolution centered on Fiat factories in Italy (and the post-workerist movements that followed), highlighting the global character of these struggles and their formative role in contemporary environmental politics.

This chapter primarily draws upon Peccei's own writings, archival materials from the Hubert H. Humphrey Papers at the Minnesota Historical Society, and secondary literature, including Gunther Pauli's biography of Peccei and the James Brennan's (1994) detailed history of labor politics in the automobile industry in Córdoba, Argentina (the

center of Fiat's operations in the country), which I bring together to develop a unique historical narrative and analysis of the *Limits* project. The chapter is an outlier in the sense that, in keeping with the genealogical method, it charts the history of global futures that did not occur. Peccei's vision of a global management authority that, through a combination of paternalism and coercion, would restabilize political-economic equilibrium on a global scale proved incompatible with the changing class dynamics in the wake of Fordist crisis. Nevertheless, elements of this vision persist, and morph, throughout the process of counterrevolution, in the formation of a transnational capitalist class (of which Peccei was an early advocate) that would be a powerful force in the consolidation of neoliberalism on a world scale; the geographies of foreign investment, production and debt that would define the neoliberal transition; and a changing balance of geopolitical power among industrialized and developing countries. In this way the chapter shows how the politics of the global environment, and the new forms of knowledge production developed to envision environmental futures, were an open field of struggle and possibility in the 1970s.

Chapter 3 picks up where the previous chapter left off to trace the emergence of *resilience* as a new ontology of nature that subtends neoliberal biopolitics. Breaking with the earlier generation of systems theory exemplified by *The Limits to Growth* that was premised on the maintenance of stable equilibrium, resilience theory posits that ecosystems are characterized by multiple equilibria and dramatically unstable dynamics, demanding new approaches to ecological monitoring and management. Tracing the early formulation of resilience theory through ecologist C.S. Holling's tenure at the International Institute for Applied Systems Analysis (IIASA), I argue that resilience

posed a new response to environmental crisis, one not predicated on maintaining stability within fixed limits, as in the *Limits* report, nor on fundamentally transforming the global economy, as in the Bariloche model (both of which were presented and debated at IIASA). Rather, its aim was the adaptive management of the 'resilience' of social-ecological-economic systems in order to enable them to persist in instability. By developing concrete strategies to govern "complex life" (Chandler 2014), resilience underpins a neoliberal biopolitics that does not aim to maintain the immunity of the social body against internal contagion and external threats, but instead works to foster growth and innovation precisely *through* exposure to alterity and risk. Based on archival research at IIASA, I show how the field of ecology became a key site for the production of new forms of governance that characterize the neoliberal era: working with leading figures in decision analysis, operations research, economics, and management science, among other fields, Holling envisioned and developed the concept in an interdisciplinary context as a universal systems language that would address conjoined problems in ecology, economics, and social and institutional management. This chapter shows the evolution of systems thinking from the reactive understanding of limits, which proposed ecological balance as an external norm to be imposed, to a counterrevolutionary orientation that internalized complex life as a new ontology of nature to which liberal government would have to adapt.

But while critics of resilience have stressed the concept's complicity with neoliberal governance, my focus on Holling's work at IIASA shows that the political implications of resilience were not pre-determined in its early history. In addition to my own archival work, I draw on the historical research of Egle Rindzeviciute (2016) and

Johanna Bockman (2011) to demonstrate that, at IIASA, resilience theory was at the center of an international and interdisciplinary research program designed to promote East-West collaboration on systems analysis, in which the relation among decentralization, markets, and state planning was not pre-determined. Moreover, the new governmental strategies arising out of this work were deployed not only in capitalist societies, but also in the socialist bloc through liberalizing reforms. In this way, the chapter argues that while resilience developed an ontology of nature that has become fundamental to neoliberal governmentality, this was the product of historical contingency rather than some essential fit between resilience and neoliberal theory. It thus suggests a more empowering critique of resilience in the present, while also pointing to the counterrevolutionary origins of neoliberal biopolitics.

If the previous chapters took a series of cuts through the environmental crisis of the 1970s and its immediate aftermath, the final chapter jumps ahead to 1989 to examine the *Exxon Valdez* oil spill as a constitutive moment in the formation of neoliberal environmentalism and in the neoliberal turn more broadly. Focusing on regulatory debates following the spill that took up the question of how the value of non-market environmental resources should be measured in damage assessments, I trace the linked histories of environmental valuation, corporate greening, and financialization that have shaped the neoliberal era and its implications for conservation. In doing so, I examine how various elements of neoliberal environmentalism introduced in earlier chapters were brought together in response to the urgency presented by the spill and the dramatic response it generated. My primary materials include US environmental rules and regulations; the transcripts of congressional hearings pertaining to the *Valdez* spill

published in the Congressional Record; and the transcript of a public meeting on environmental valuation in 1992, held by a panel of leading economists sponsored by NOAA to make recommendations on environmental valuation for the Oil Pollution Act of 1990. Further background information is provided by an interview with NOAA panel member Paul Portney.

The chapter thus provides insight into how neoliberal environmentalism has come together as an apparatus of government in response to particular urgencies, and also how this process has been formative of neoliberal governance in general. Taking up Foucault's analysis of neoliberalism in his later lectures, I show that the environmental valuation debates contended with a defining problematic of neoliberalism: namely the nature of economic rationality, and the extent to which this rationality pertains to social behavior in general. The problem of rationalizing environmental values was therefore not simply about applying market rationalities to the natural world, but rather entailed redefining these rationalities themselves. Furthermore, in these debates environmental valuation was posed as a political problem that concerned the role of economics in public policy, the degree of corporate control over environmental regulation, and the definition of new and potentially incalculable environmental risks. The problem of environmental valuation in the wake of *Valdez* not only helped to shape the kinds of methodologies that are used to measure the value of natural capital in the present, but also had more far-reaching implications for corporate environmental governance, economic theory, and financialization. These "afterlives" (Ross 2015) of the *Valdez*, I argue, suggest that environmental valuation is a formative political problem through which neoliberalism as we know it has come to be. At the same time, by addressing the Valdez disaster through

Ross's notion of 'afterlives,' this case helps me to reflect on the temporality of counterrevolution as it is developed in the previous chapters. In this way I return to the definition proposed in this introduction in order to posit an understanding of neoliberalism as a project of crisis-management.

The concluding chapter pulls together the major threads running through the previous chapters to explore the implications of this genealogy for the critique of neoliberal environmentalism in the present. I develop the concept of infrastructural nature introduced in the first chapter to argue that, more than a new frontier of commodification, what is at stake in the rise of ecosystem services and natural capital is a process of rendering nature *infrastructural*: that is, of defining, measuring, and valuing the functions of ecosystems that sustain (certain) human lives. I return to current discussions on value and labor in the geographical literature on neoliberal environmentalism to show how this approach offers a new critical orientation to ecosystem services and natural capital as a site of struggle over what the labor of social-ecological reproduction involves, and how its value will be socially recognized. This approach presents opportunities for the critique of neoliberal natures to move beyond accounts of nature's commodification, to ask how maintenance and reproductive work might be (or is already being) valorized beyond and against capital. In the process, it pushes critical political economy to reconsider key categories of labor, reproduction, and value.

Finally, a brief note on the methods and materials involved in this research. Alongside the historical research represented in these chapters, my approach has been shaped by my participation in international conferences and intergovernmental processes pertaining to environmental valuation and ecosystem services throughout the past four

years. As originally conceived, this dissertation involved a substantial focus on the politics of environmental valuation and ecosystem services in the present, and my research has taken me to intergovernmental processes in Turkey, France, Germany, and Peru; to sugarcane plantations in Colombia; and to international conferences in Costa Rica and Washington DC. It has also led me to ongoing participation in the activities of the Natural Capital Project, a collaborative venture among The Nature Conservancy, the World Wildlife Fund, Stanford University and the University of Minnesota, which is a leader in the development of software-based tools for ecosystem service valuation. These research activities have involved interviews with dozens of leading practitioners, corporate managers, government delegates, and scientists involved in environmental markets and natural capital valuation. In the end, I determined that the historical work demanded the space of the dissertation unto itself, and that the contemporary work would be better suited to other projects. Nevertheless, these research activities are an essential condition of the project as a whole, even as they remain in the background, insofar as they have enabled me to define the present conjuncture of which the current project is a history. In other words, it is through my involvement in a variety of arenas in which environmental values are being actively negotiated that my understanding of neoliberal environmentalism has taken shape.

The story of the environment under neoliberalism, this dissertation contends, is not simply an account of a new frontier in the ceaseless marketization of life but is a political problem through which the definition and boundaries of 'the economy', the viability of the market as a framework for governing life, and the relationship of the state to the market are negotiated and contested. That is, it is not so much that 'nature' either

resists (Bakker 2004) or is flattened under (Sullivan 2010) a neoliberal logic of marketization, but that the problems, contradictions, and debates about environmental valuation are significant moments through which actually-existing neoliberalism has come to be, and through which it might yet be overcome.

Chapter 1: Environmental crisis and the problem of reproduction

A recent report from The Nature Conservancy (TNC 2016:2) makes a matter-of-fact statement: "Ecosystems are infrastructure." In the case of concern to the report – investment in watershed conservation in Peru – ecosystems' infrastructural features include their ability to "generate important economic services as they maintain the quantity and quality of water supplies and help mitigate or avert water-related disasters." In other words, ecosystems are infrastructure insofar as their functions underpin economic activity, ensure the consistent delivery of essential resources, and secure the lives of populations against disaster. The problem, for the report, is that these functions remain invisible to social policy. Making ecosystems visible as infrastructure thus requires new calculative tools for assessing their value, and new institutional arrangements for catalyzing investment in their conservation.

The report's statement articulates a paradigm shift in environmental thought and governance in the past few decades, in which nature is increasingly measured, managed, and valued as a provider of essential *services* (such as carbon sequestration or nutrient production) rather than a static stock of resources (e.g. Daily 1997, TEEB 2010, MEA 2005). Often distilled in the notion of 'ecosystem services' – used to describe the benefits ecosystems provide to human societies (MEA 2005) – this infrastructural understanding of nature is subject to a range of new strategies for catalyzing investment into conservation, including novel ecosystem service commodities and environmental markets (Smith 2007; Robertson 2012; Sullivan 2013). Ecosystem services operates as a new analytical framework within which nature's value can be assessed, facilitating new valuations of land and resources formerly deemed waste by economic standards. For instance, the Millennium

Ecosystem Assessment, coordinated by UNEP as the first major global assessment of ecosystem services, offers the example of an "apparently worthless" swamp, which within the framework of ecosystem services can be seen to "perform a wide range of functions of great value to people — from acting as a natural pollution filter and preventing floods by storing water during heavy rains to supporting wildlife and recreation" (MEA Board 2005:9). Methodologies for measuring ecosystem services as natural capital have been mainstreamed through the United Nations Environment Program (MEA 2005), the World Bank (WAVES 2014), and major environmental nongovernmental organizations such as The Nature Conservancy, Conservation International, and the World Wildlife Fund. Payments for Ecosystem Services (PES) programs, which provide direct payments or incentives to landholders to undertake land use changes that promote conservation outcomes, have become a defining feature of environmental policy around the world.

Aside from nature's infrastructural functions, however — often termed "regulatory services" (MEA 2005) — we are increasingly told that all aspects of human-nonhuman relations that give our lives meaning can be understood as 'services;' new methodologies for valuing the cultural, aesthetic, and spiritual value of nature abound (e.g. Jarvis et al. 2017; Raymond et al. 2016; Baulcomb et al. 2015; Miclu et al. 2013). As the framework of ecosystem services has been mainstreamed, it has increasingly become so capacious as to prompt ecosystem service researchers to question its analytical value.[15] The question of whether nature's value can be adequately comprehended as a set of 'services,' and how these values should be measured and recognized in public policy, now constitutes some of the most highly-contested issues in contemporary environmental politics.

[15] This statement is based on experience in meetings and reading groups with members of The Natural Capital Project between 2014 and 2016, where debate over the meaning and usefulness of the term was ongoing.

In this chapter, I trace the early history of the concept of ecosystem services as it emerged in the 1960s and '70s in the context of a series of challenges to the Fordist-Keynesian regime of accumulation that I term *environmental crisis*. Whereas theorists of post-Fordist transition such as Antonio Negri and Paolo Virno have focused on the transformation of labor under the guise of 'human capital,' this chapter charts the related process by which the economic category of land was re-conceptualized in terms of 'natural capital,' and shows that these developments were linked via the discourse of the service economy. Following a brief review of existing approaches to the history of ecosystem services, I begin by theorizing the problem of social-ecological reproduction, drawing on the work of Marxist-Feminists such as Leopoldina Fortunati and Silvia Federici. I then describe how this problem took shape in the historical context of environmental crisis, which I use to name a breakdown of the boundaries of 'the economy' as a technology of government (Mitchell 1998) – a breakdown that was signaled by widespread recognition of the need to account differently for both social and ecological reproduction.

But the problem of natural capital was not merely a technical one demanding new forms of accounting. Rather, the biophysical challenges posed to industrial production became consequential in the context of a broader social transformation of values, most forcefully expressed in the environmental movement and other so-called new social movements. Reviewing the debates over natural capital and post-industrial growth within the emerging fields of environmental and ecological economics, I argue that early notions of ecosystem services dealt with two interlinked problems: 1) how economics should contend with new environmental values, and 2) how it should account for what I will call

the infrastructural functions of ecosystems. I show that these problems were linked through an understanding of economic activity in terms of the production and consumption of services, an understanding which also inflected early notions of human capital. But while these different types of services were overlapping and interdependent, each presented different conceptual challenges to economic thought and responded to different political pressures. By way of illustration, I show how these problems played out in a global geopolitical context by highlighting an unacknowledged history of ecosystem services at the 1972 UN Conference on the Human Environment. At that event, developing countries debated whether and how they should exploit the "pollution absorption capacity" of their environments as a comparative advantage for attracting industrial investment. This example shows that the question of how an infrastructural nature might be rationally managed and exploited was already a matter of concern in the 1970s, prior to the 'mainstreaming' of ecosystem services in the 1990s.

This account complicates existing histories of ecosystem services by showing how the concept emerged not simply as a strategic buzzword, but as a response to a series of interlinked problems regarding the meaning of environmental limits for economic growth, the definition of the economy, and the shape of a post-Fordist international economic order. As I return to in the dissertation's conclusion, the tensions among these various problems persist in the present. By showing that the problem of natural capital in the 1960s and '70s was an effort to contend with both the 'refusal' of biophysical systems to conform to the demands of industrial production and also with values antagonistic to accumulation that were expressed in new social movements, the chapter introduces the argument that an understanding of nature as capital was part of what Virno (1996) calls

the counterrevolutionary turn, whereby the political challenges posed to Fordist-Keynesianism in the 1960s and 1970s were redirected into a new regime of accumulation in the 1980s and 1990s.

Genealogies of Ecosystem Services

The history of ecosystem services tends to be narrated in one of two ways: either as a well-intended conservation strategy gone wrong, or as a capitalist strategy to commodify the conditions of life (or both, insofar as the latter involves the cooptation of the former). In the first narrative, the origin of the concept of ecosystem services is found in its utility, in the sense that framing ecological functions in economic terms provided conservation advocates with a strategic language with which to drum up support for conservation investments. For instance, in their history of ecosystem services in economic thought, Gomez-Baggethun et al. (2010:1209) write that "[t]he origins of the modern history of ecosystem services are to be found in the late 1970s… with the utilitarian framing of beneficial ecosystem functions as services in order to increase public interest in biodiversity conservation." This account is supported by major proponents of the ecosystem services concept (e.g. Daily 1997). It is also mobilized by sympathetic critics of the marketization of ecosystem services, insofar as it describes a singular origin of ecosystem services (as a well-meaning compromise on the part of conservation advocates) from which the concept has strayed, and to which it could presumably be returned (e.g. Peterson et al. 2010; Gomez-Baggethun et al. 2010).

In the second narrative, the rise of ecosystem services is treated as one result of the general marketization and commodification of life undertaken in the neoliberal era. Within the critical geographical literature for instance, ecosystem services have generally

been treated as an instance of the neoliberalization of nature, even as its "most distinctive" feature – enabling nature to circulate as "*credits, information*, or *services*, purportedly unbound from material essences and free to move through global circuits of credit and finance commodities" (Dempsey and Robertson 2012:2). The prominence of ecosystem services as a framework for environmental management has led Morgan Robertson (2012:387) to restate Marx's famous opening to *Capital*, to claim that "the ecology of societies in which the capitalist mode of production prevails appears as an immense collection of services."

A tension persists in these critical accounts, however, between an insistence on the diversity of concrete instantiations of ecosystem services, and a tendency to locate (either implicitly or explicitly) the origins of the concept in an unfolding logic of capital that drives processes of neoliberalization – even where this may be more or less frustrated by "uncooperative" (Bakker 2004) material natures. What unites these critiques is a tendency to see ecosystem services as a *solution* to capital's contradictions vis-a-vis the environment (e.g. Castree 2008a, Smith 2007)[16]. This both reintroduces an understanding of the origin in terms of utility (that is, the concept arises and becomes dominant because it is useful to a broader project of neoliberalizing nature), and tends toward a "suprahistorical perspective" (Foucault 1984:86) that sees the logic of capital as a singular cause that unifies the diversity of current forms of ecosystem service policy and practice, and predetermines their political implications.[17] Furthermore, in both of these

[16] In Castree's schematic, neoliberal environmentalism refers to "Environmental Fix 1". See Castree 2008a:146-147.

[17] "Let's say roughly that, in contrast with a genesis oriented towards the unity of an originating cause pregnant with a multiple descent, it would be a matter of a genealogy, that is to say something which tries to reconstruct the conditions of appearance of a singularity on the basis of

narratives the term 'ecosystem services' tends to be conflated with the concept(s) to which it refers, and commonly attributed to Paul and Anne Ehrlich's 1981 book *Extinction* (e.g. Gomez-Baggethun et al. 2010; Dempsey 2016:94). These narratives thus focus on the intellectual history of the term without attending to the conditions of possibility that enabled this perception of the biosphere as a planetary service economy in the first place.

How, then, might a genealogical approach prompt us to re-evaluate the rise of ecosystem services? In other words, how might we trace the development of ecosystem services as a *problem* rather than as a solution? In his insightful evaluation of neoliberal environmentalism in general, and ecosystem services in particular, as a transformation of our "core socio-economic relationship with nature," Neil Smith (2007:19) notes offhand that, "Ironically," the new environmental commodities of the 1980s and 1990s "owe their existence, first and foremost, to the success of the environmental movement in the 1960s and 1970s" (Smith 2007:20). But we might augment Smith's account by taking this irony seriously. That is, we might consider this lineage ironic in the sense that it is an inversion of radical impulses, the process whereby a radical disruption is (partially and provisionally) redirected to become a new catalyst for accumulation.[18]

It is with this sense of irony that Paolo Virno (1996) builds his historical analysis of neoliberalism as *counterrevolutionary*, in the sense that it mobilized "the very same (economic, social, and cultural) tendencies that the revolution would have been able to engage,'" but inverted and reduced these to "profitable *productive forces*" (Virno

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multiple determining elements, from which it arises not as the product, but as the effect" (Foucault 2008:49, note 8).

[18] See also Braun 2015a for a different but related take on the ironic origins of neoliberal environmentalism.

1996:241, original emphasis). In this sense, Virno defines counterrevolution as "literally *revolution in reverse*" (241). However, if Virno argues that the crisis of Fordist-Keynesianism was precipitated by the resistance of labor-power, the widespread discourse of environmental crisis discussed in this chapter suggests that it was also catalyzed by the refusal of ecological systems to conform to the demands of existing resource management practices.[19] This ecological dimension has been largely ignored by Virno and other autonomist thinkers, who have instead privileged the cognitive and communicative dimensions of labor in the "social factory" (Negri 1996).

Addressing the ecological dimensions of the counterrevolution requires that we revisit and revise the discussion of value pursued in the introduction, in which we took the category of labor-power largely at face value. In the midst of the autonomist movements, Italian feminists pointed out that, if capital confronts labor-power as the "general possibility" of wealth, what is occluded in that encounter is a vast iceberg of productive activity that enables the wage laborer to appear as value's "living source". As Leopoldina Fortunati (1996:7) writes, "it is only by re-defining the individual as non-value, or rather as pure use-value, that capital can succeed in creating labor power as 'a commodity,' i.e. an exchange-value." The "valuelessness" of the worker presupposes a division between the spheres of production and reproduction, such that "the first appears as the *creation* of value, [and] the second, reproduction, appears as the creation of *non-value*" (ibid.:8). Thus capital's ability to confront labor as use-value for capital entails a constitutive blindness to this broader sphere of reproduction, which must appear as "natural production": "*It is the positing of reproduction as non-value that enables both*

[19] For a related approach to ecological 'resistance' to capitalist appropriation, see Moore 2015.

production and reproduction to function as the production of value" (9; original emphasis).

This entails important implications for the concept of labor-power: while capital encounters the general potential for wealth through the worker, the worker is not the definitive source of this potential, but only appears so by virtue of the occlusion of a much larger sphere of productive activities. This means that the reproduction of capitalist social relations entails not only the continual disenfranchisement of the worker, but also the continual reinscription of the division between production and reproduction. This division is therefore historically contingent and historically shifting. If both capital and laborer are the product of labor's alienation, labor as Marx described it – individuated in the (gendered, raced) human body – is also the product of a particular organization of reproduction.

Modifying Fortunati, however, the problem of natural capital forces us to understand the reproduction of labor-power as always more-than-human. Following Jason Moore (2015), we might think of the division between production and reproduction in terms of a distinction between exploitation and appropriation. Drawing on Marxist-Feminist theorists and taking up George Caffentzis's (1980/1992) concept of "work/energy," Moore (2015:53) links the appropriation of unpaid reproductive labor with the appropriation of the unpaid work/energy of extra-human natures. He argues that any increase in labor productivity is predicated on the production and appropriation of "Cheap Nature," in the form of "a rising stream of low-cost food, labor-power, energy, and raw materials to the factory gates." The law of value, Moore argues, is therefore "a law of Cheap Nature".

For Moore, abstract social labor therefore depends on the production and appropriation of "abstract social nature", a process that entails new scientific practices and measurement techniques alongside direct forms of violence and dispossession. The reproduction of abstract social nature is founded on what Moore calls the "Cartesian binary," by which he refers to a nature-society dualism that pervades capitalist ideology (and also, in his view, most critiques of political economy).[20] But while Moore treats the shifting dynamics of how and where "Cheap Natures" are produced as the history of capitalism, the dualism that for him is fundamental to rendering nature cheap remains untroubled by this history. Moore (2015:82) writes that it is not the task of world-ecology to explain "the separation of humanity and nature." In this way Moore leaves the category of labor unproblematized, sidelining qualitative changes in the way that socio-ecological capacities are both exploited and appropriated.[21] Whereas Moore situates both human and nonhuman resistance to capital on a continuous terrain of class struggle, his ideology critique of Nature/Society staves off the perhaps more radical question of how that binary, and its relation to the division between appropriation and exploitation (or reproduction and production), has shifted over time as an *object* of this struggle. I contend in this chapter that the concept of ecosystem services articulates a crisis of a

[20] Moore uses the "Cartesian binary" as shorthand for the Nature/Society dualism that he sees as foundational to both capitalist ideology and critical environmental thought. That Descartes's dualism posed an ontological split between body and mind, not nature and society, does not merit discussion in Moore's work; we are left to assume that this maps onto contemporary Nature/Society dualisms.

[21] For instance, whereas autonomist theorists have emphasized the uneven temporalities of exploitation in contemporary capitalism, capitalism for Moore remains characterized by the time of the factory, and he risks conflating the production of equivalence in the realm of exchange with the production of homogeneity in time and space (Moore suggests that nature rebels not against exploitation as such, but because "no one, no being, wants to do the same thing, all day, every day" [2015:205]).

particular historical iteration of this division, one that was rooted in the modern notion of the 'economy.'

Environmental Crisis in the Short American Century

At the very moment when Nature 'refuses to give its gifts in abundance,' the 'Nature' within society, the woman, refuses its place.

– George Caffentzis[22]

As Timothy Mitchell has argued, the mid-20th century capitalist order was shaped by the production of "the economy" between the 1930s and the 1950s as a "self-contained and dynamic mechanism," a discrete sphere of social activity that had its own growth dynamic and could interact with other spheres, such as the state (Mitchell 1998:82-101). In Mitchell's historical account, the production of the economy figures as central to a new world order that coincides with what Frederic Jameson (1991:xx) has termed the "brief 'American century'" spanning 1945-73. As Morgan Adamson (2012:807) argues, this period was characterized by "the dual stabilization of the global monetary order in the wake of the collapse of the 1930s and the brief stabilization of relations between capital and labor in the wake of the labor militancy that ensued." For Adamson, the "Keynesian pact" of the American century linked labor-capital relations directly to the Bretton Woods monetary order that established the hegemony of the US dollar as the global reserve currency.

Linking this periodization to Mitchell's analysis, we can describe the American century as underpinned by the production of the economy in two primary ways: first, the position of the US dollar as the global reserve currency depended upon the dominance of US manufacturing, which itself was achieved through the Keynesian accord between big

[22] In Caffentzis 1980/1992:251.

labor, big capital, and big government (Harvey 2005). By the 1950s, the new science of the economy had become a privileged field of knowledge in US policy making (Mitchell 1998:88), underpinning a politics of economic growth (measured by GNP) that was instrumental to maintaining the geopolitical position of the US. Second, the production of the economy as a spatially-fixed, nationally-bounded entity with a normative tendency toward unbounded growth was central to the establishment of a new world order following the decline of nineteenth-century empires. By reframing growth not as the external expansion of imperial power but as "the internal intensification of the totality of social relations defining the economy as an object" (Mitchell 1998:90), the discourse of the economy underpinned a new imperial anti-politics of "development" that would come to characterize US intervention into the affairs of newly-sovereign postcolonial states.

As Mitchell (1998:93) writes, "To create the economy meant also to create the non-economic." While Mitchell focuses on the necessary devaluation of subsistence production and social reproduction, the coherence of the economy also required the exclusion of ecological reproduction from the domain of the properly economic. One of the key features in the paradigm shift from the classical to the neoclassical period, inaugurated by the marginalist revolution of the 1870s, was the gradual excision of environmental conditions of production from economic analysis. For classical economists, land was a "non-substitutable production input," a perspective which underlined the notion of physical limits to growth present in Ricardo (in the law of diminishing returns to land), Malthus (in the idea of immutable limits to population growth), and Mill (in his notion of a 'steady-state economy'). Land, alongside labor, formed one of the key inputs to the production process, underlying the formation of use-

values but not directly factoring into exchange-value (Gomez-Baggethun et al. 2010:1211).[23] With the marginalist revolution, the category of land was gradually replaced by the category of capital as the key input alongside labor.

The production of the 'economy,' as a historically specific articulation of the division between production and reproduction, relied on this blindness to its own environmental conditions. Interest in issues such as resource depletion would languish throughout the 1930s, a period when the idea of the substitutability of monetary capital for natural resources gained popularity (Gomez-Baggehun et al. 2010). In the "Keynesian-Neoclassical synthesis" that dominated mainstream economics during that period, the imperative for economic growth as measured by GNP depended on an environment that was unlimited in its functions as both source and sink. The environment was the constitutive outside of the economy in both a literal sense as the source of material inputs and repository for waste, and in a discursive sense as the field of material wealth and productive activity in contradistinction to which the economy's boundaries must continually be drawn.

By linking Adamson's and Mitchell's accounts, however, we can observe that almost as soon as the economy came into being as a coherent object of governance, it was thrown into crisis. In the 1960s, the balancing act between capital, labor, and the state necessary to maintain the Fordist-Keynesian link between mass production and mass consumption, and upon which the hegemony of the US dollar depended, was shaken by what Marxist political economists have generally characterized as a falling rate of

[23] On this Marx and Ricardo broadly agreed. In his Critique of the Gotha Program, Marx dismissed the "dull and tedious quarrel over the part played by Nature in the formation of exchange-value. Since exchange value is a definite social manner of expressing the amount of labor bestowed upon an object, Nature has no more to do with it, than it has in fixing the course of exchange" (quoted in Gomez-Baggethun et al. 2010:1211).

productivity leading to a declining rate of profit (Surin 1996:207, note 6). The gains made by organized labor in linking rising wages to rising productivity, which had been the Keynesian answer to the problem of effective demand, combined with rising oil prices (most forcefully in the "oil shock" of 1973-4) to narrow profits in manufacturing and foment widespread concern over an impending energy crisis (Arrighi 2010:315). Declining profit rates in manufacturing in conjunction with loose monetary policy fueled the "stagflation" that would confound mainstream economic theory. Meanwhile, US military expenditures to combat Third World communisms had contributed to resistance to US imperialism as well as a balance of payments deficit, as the US transitioned from being the world's largest creditor to being its largest debtor (Magdoff and Sweezy 1972). As a stagnant manufacturing sector and low federal interest rates drove capital to seek greater returns overseas, trading in international currency markets beyond national regulation fueled the proliferation of dollars beyond US gold reserves, precipitating Nixon's 1971 declaration that the dollar would no longer be backed by gold (Arrighi 2010:312).

It was in the context of these economic and political disturbances to Fordist capitalism and US hegemony that the environment emerged as an object of politics.[24] The 1960s and 1970s saw a proliferation of literature in which the global environment, rather than an inert collection of resources, came to be seen as a set of integrated complex systems whose dynamics defied prediction and whose biophysical limits threatened economic growth (e.g. Lovelock and Margulis 1974, Ehrlich 1968, Carson 1962, Meadows et al. 1972). In 1962 Rachel Carson's seminal work *Silent Spring*, widely

[24] On the environment as an object of politics in the context of the 1973-74 oil crisis, see Mitchell 2012.

credited with inaugurating the modern environmental movement, revealed the toxic threats emanating from consumer culture – threats which were later borne out in high-profile pollution events like Love Canal and Three Mile Island. Meanwhile, the rapid decline in native fish populations in the Great Lakes and the partial collapse of the northwest Atlantic cod fishery in the 1970s signaled the failure of established Maximum Sustained Yield strategies for resource management in the context of complex ecological linkages among pollution, fishing, and invasive species (Mills et al. 2005; Frank et al. 2005).

These emerging problems were seized upon by a growing environmental movement in the US and Europe that challenged growth-oriented economic policy and the impacts of industrial development. The success of the movement to ban DDT in the US, inspired by Carson's *Silent Spring*, demonstrated the power of environmentalism as a political force capable of fomenting massive shifts in industrial regulation. In 1969, grassroots mobilizations following the offshore oil rig blowout near Santa Barbara successfully halted oil lease sales off the California coast (Mitchell 2012). By the mid 1970s, the anti-nuclear movement had become a significant force shaping national energy policy in the US, UK, Germany, and elsewhere. In the context of the broader countercultural movement that articulated a critique of consumer culture, environmentalism became an important force articulating values contrary to mainstream capitalism, and one capable of exerting a significant impact on industry.

The prospect of environmental limits to postwar growth presented itself as a problem of both scarcity and excess: scarcity of energy and resource supplies, and excess

of uncontrollable externalities, namely pollution and spectacular environmental disasters. As George Caffentzis (1980/1992:215) wrote:

> Whereas in the 1950s and 1960s Nature was 'under control' and the robots (e.g., Hal in 2001) were rebelling, now it appears that Mother Nature is turning a new face. Instead of the obedient, invisible and infinitely malleable material of social development, the terrestrial abode seems stingy and treacherously seductive.

These concerns unfolded in the new geopolitical terrain emerging with the rise of Third World independence, for instance in the 1973 'oil shock' initiated by the newly-formed OPEC in response to US support of Israel during the Yom Kippur war. As Mitchell (2012) has compellingly argued, oil companies were quick to seize on the emerging environmental awareness to transform this political maneuver into a general 'energy crisis,' in an attempt to regain control over oil prices. Thus while the oil shock was widely taken as proof of predicted limits to growth, it more accurately represented a crisis of the system of dependency that had ensured the economic subordination of Third World nations, showing that this system worked both ways. Anxieties over the relative balance of power in the global economy also surfaced in a revival of Malthusian fears over Third World population growth, most visibly articulated in Paul Ehrlich's (1968:1) irredeemably xenophobic bestseller *The Population Bomb*, which is prefaced with the author's description of his horror at the sight of the Indian bodies that filled the street in front of his taxicab "one stinking hot night in Dehli," leading him and his wife to wonder: "*Would we ever get to our hotel?*"

One of the most influential articulations of impending environmental crisis, explored in the next chapter, was the Club of Rome's 1972 report on *The Limits to Growth*. That report was motivated by the Club's concern with what it called the "World Problematique," a "meta-problem" manifested in all dimensions of social life, from

pollution to the youth movement. The *problematique* included "poverty in the midst of plenty; degradation of the environment; loss of faith in institutions; uncontrolled urban spread; insecurity of employment; alienation of youth; rejection of traditional values; and inflation and other monetary and economic disruptions" (Watts 1972:10). An early articulation of the *problematique* highlighted that the novelty of the situation inhered in the complex causalities that connected these problems on multiple scales:

> Hence if we extend, as is increasingly being done nowadays, the definition of ecology to comprise all the dimensions of occurrence in our world-wide environments it becomes possible to say that we are confronted with a problematique which is *ecosystemic in character* (Hasan Ozbekhan, quoted in Elichirigoity 1999:79; my emphasis).

The crisis as articulated in this literature was both *ecological* and *environmental*: it was *ecological* in the sense that it was not the product of a single cause or group of causes, but emergent from the totality of relations that made up modern society. As explored in Chapter 3, ecology in this context gained new salience in popular culture as a general descriptor of complex relationality. No longer confined to the dynamics of nonhuman populations, ecology described the relations of immanent causality manifested in a new moment of globalization, but in a perverse form — as an impending apocalypse without cause, or whose cause is the totality itself. This generalized crisis was neither strictly internal nor external to the economy as such, but was coextensive with the mode of production in the broadest sense. In this sense, it articulated a crisis that was also *environmental*: a crisis of the boundaries of the economy itself, of the relation between the economy and its outside. As Melinda Cooper argues, *The Limits to Growth*

> gave voice to the prevailing consensus that Fordist manufacture had entered a period of irreversible decline. But it also brought something palpably new to the analysis. If there was a crisis in the offing, it was not one that could be measured in conventional economic terms – a crisis in productivity or economic growth rates – but rather a wholesale crisis in the realm of reproduction. For the Club of Rome what was at stake was no less than the

continuing reproduction of the earth's biosphere and hence the future of life on Earth (Cooper 2008:16).

In the 1960s and 1970s, the discourse of "environmental crisis" signaled a crisis of 'the economy' as both an object of knowledge and an apparatus of government. This discourse connected disparate concerns about faltering economic growth, pollution, energy security, resource collapse, New Left and other social movements and (as explored in the next chapter) their alignment with resurgent labor militancy. But this is not to assert that it was a mere ideological reflection of underlying 'economic' problems. The apparent crisis registered an intrusion of forces, irreducibly more than human, which refused to be 'put to work' toward the reproduction of capital. As explored further in the next chapter, in that historical moment the environment was not a discrete object of politics, but a set of interconnected problems and concerns entangled in geopolitical upheaval, economic change, and a new era of globalization.

This understanding of environmental crisis enables us to take a broader view of what Antonio Negri describes as a crisis of measure in post-Fordism. For Negri, the crisis of the 1970s was not simply an unfolding of structural contradictions, but the result of a qualitatively new type of labor struggle that entailed the wholesale refusal of work as such.[25] It was this refusal of work that, for Negri and other theorists of the autonomist movement, precipitated a collapse of labor-time as the measure of value. No longer individuated in the wage worker, in post-Fordism labor – and thus its antagonistic relation with capital – pervades the whole social field (Negri 1996). Negri (1996:156)

[25] Mario Tronti (1965/2007:30) theorized this "strategy of refusal" based on the assertion that what labor gives to capital is not work (a claim that underpins arguments for better remuneration for that work), but the conditions of capital itself – and vice versa: "What are workers doing when they struggle against their employers? Aren't they, above all else, saying 'No' to the transformation of labor power into labor? Are they not, more than anything, refusing to *receive* work from the capitalist?"

therefore argues that post-Fordism is characterized by the hegemony of the "social worker" over what he calls the "mass worker" of industrial capitalism, the former defined as "the complex of functions of laboring cooperation transported into the social productive networks." This entails a transformation of the boundary between production and reproduction: "in effect," Negri (1996:157) writes, "productive labor is no longer 'that which directly produces capital,' but that which reproduces society – from this point of view, its separation from unproductive labor is completely dislocated."

What Negri characterizes as the breakdown in the division between production and reproduction has been more extensively theorized by Marxist-feminist scholars and activists, who in the 1970s pointed to reproductive labor as a key site of anticapitalist struggle. Silva Federici (1980/2012) argued that it was the refusal of work not only within the factory, but also in the sphere of social reproduction that prompted a transformation of (re)productive labor. Through protests against welfare reform and the Wages for Housework movement, Federici (1980/2012:42) argued, "women have triggered a major reorganization of social reproduction that is putting into crisis the prevailing sexual division of labor and the social policies that have shaped the reorganization of reproduction in the postwar period."

Federici highlighted two manifestations of this refusal. First was the widely-debated rise of the 'service economy' in the wake of industrial decline (e.g. Bell 1974; OECD 1967; Gershuny 1977). With the services of social reproduction increasingly transformed into waged work outside of the home, "*we see the reproduction of labor power assume an autonomous status in the economy with respect to the production of commodities*, so much so that the productivity of reproductive work is no longer

measured (as it used to be) by the productivity of the male worker on the job, but directly at the point where the services are delivered" (Federici 1980/2012:50, original emphasis). Second, accompanying this shift were efforts by economists and policymakers to measure the contributions of reproductive labor to GDP. The sudden visibility of reproductive labor came in response, Federici argued, to the need to re-stabilize social reproduction by drawing these activities into the sphere of economic calculation.

The debates over the significance of the service economy for post-industrial growth and the efforts to account for reproductive labor were linked through the emerging notion of human capital. This notion was pioneered by Gary Becker (1964/1993), a neoliberal economist who would win the Nobel Prize for his theory of Household Production, which reimagined consumption as a process of the production of 'human capital.' As Foucault (2008:244) writes, examining Becker's account of mothering as a process of investment in human capital, it also entailed a dramatically expanded understanding of income:

> And what will this investment constitute? It will constitute a human capital, the child's human capital, which will produce an income. What will this income be? It will be the child's salary when he or she becomes an adult. And what will the income be for the mother who made the investment? Well, the neoliberals say, it will be a psychical income. She will have the satisfaction a mother gets from giving the child care and attention… So everything comprising what could be called, if you like, the formative or educational relationship, in the widest sense of the term, between mother and child, can be analyzed in terms of investment, capital costs, and profit – both economic and psychological profit – on the capital invested.

Whereas the traditional economic understanding of utility serves to explain the subjective basis of economic value, here utility – referring to the general satisfaction derived from social interaction – becomes an end in itself; its relevance to economic analysis no longer requires that it be expressed in a monetary transaction. As will be

explored more deeply in Chapter 4, the notion of human capital thereby opened economics to a much broader analysis of social behavior than that encountered in markets. At the same time, it suggested that the household constituted a "unit of production in the same way as the classical firm" (Foucault 2008:245; quoting Jean-Luc Migué), providing an analytical tool for rationalizing productivity at the level of both the individual and the population (Adamson 2009).

The role of human capital in advancing productivity, and the mechanisms governing investment in it, were explored in the emerging literature on the economic role of 'services.' In a landmark 1957 paper, Robert Solow had shown that increases in US productivity since the 1920s were the result of a "residual factor" additional to capital and labor, referring to "the particular manner in which capital and labor are combined, not only in terms of management, but also as a particular arrangement of the production and circulation of information and knowledge" (Castells 1976:602). In the 1960s and 1970s, a wide-ranging literature charting the rise and significance of the 'service economy' highlighted on the one hand the centrality of information and management to productivity, and on the other the role played by social institutions in producing and managing the collective capacities of labor-power. As the Secretary General of the OECD noted in 1964, "[t]he literature on economic growth abounds with such phrases as 'investment in human resources' and the 'third' or 'residual' factor," and with efforts to quantify the "economic advantages" of public investment in education (Kristensen 1964:5). At stake in the literature on the service economy was the question of how public and private resources might best be invested in the social networks and institutions necessary for the production of a flexible and adaptive post-industrial labor force:

> All this [Solow's 'residual factor'] suggests two overlapping ways in which we can understand how services, particularly the fast growing services, might be linked to the sources of productivity. To say that the new sources of productivity are mediated through qualitatively upgraded labor is to argue that the human services, particularly the health and education complexes, become the social loci for the developmental possibilities of society. To say that society's social networks, both informational and organizational, are the keys to the new requirements for flexibility and adaptability, is to argue for the centrality of the public services, particularly of the administrative, welfare, and planning varieties. Taken together, both arguments suggest that the full development of the forces of production, abstractly conceived, rest ultimately on the development and elaboration of the public and human services, of precisely those services that have fueled the emergence of the service society (Hirschhorn, quoted in Castells 1976:602).

This literature attempted to articulate, in traditional economic terms, the new forces of social production theorized by Negri as the 'social factory.' But while theorists of post-Fordism have focused on the transformations of labor undertaken through the analytics of human capital, they have not attended to the parallel process taking place with regard to nonhuman nature. At the same time that the traditional category of labor was being reconceptualized in terms of human capital, the category of land was being reformulated in terms of natural capital in the new fields of ecological and environmental economics. In both fields, the notion of 'services' served to link an expanded analysis of economic behavior with an understanding of new productive forces: on the one hand, those located in the relational milieu of "qualitatively upgraded labor," and on the other, those located in the more-than-human relational capacities of ecosystems.

Transforming Reproduction: The Rise of Ecosystem Services

The problem of conceptualizing and accounting for natural capital was taken up by the emerging fields of ecological and environmental economics, formalized in the 1960s with the Society of Environmental and Resource Economics (Gomez-Baggethun 2010:1212). Early on, the Society was marked by two divergent strands of thought on

natural capital and environmental valuation which have shaped the debate over environmental problems and the modern concept of ecosystem services. This debate centered on the nature of environmental scarcity and its implications for economists' understandings of growth, capital, and value.

Environmental economists operated mainly within the parameters of neoclassical economics, seeking to account for the value of natural capital while positing its commensurability with monetary and produced capital. In the midst of growing concerns over resource scarcity, they argued that markets would naturally correct for increasing scarcity, and that even if natural capital were finite, it could be replaced by technological innovation (e.g. Solow 1973). This argument depended on the notion that natural and monetary capital were perfectly fungible with one another, such that producers would have an incentive to find new substitutes for declining resources. As Robert Solow wrote: "If it is very easy to substitute other factors for natural resources, then there is in principle no 'problem.' The world can, in effect, get along without natural resources, so exhaustion is just an event, not a catastrophe" (Solow, quoted in Gomez-Baggethun 2010:1212).

This position was strongly resisted by ecological economists such as Herman Daly, Nicholas Georgescu-Roegen, and Kenneth Boulding. Influenced by the emerging science of systems ecology, they laid out a far more heterodox program that sought to renovate the discipline in light of immutable environmental limits to growth, framing this as a return to the discipline's classical roots prompted by the new science of systems ecology. Drawing the concept of the "steady-state economy" from John Stewart Mill, Daly rejected the "Keynesian-neoclassical growthmania synthesis," and saw ecological

economics as an effort to "root out the faddish political economics of growth and replant the traditional political economy of scarcity" (Daly 1980a:5, 8).

At stake in the debate over environmental limits was what a post-industrial mode of growth might look like, and the proper role of markets governing this growth. For ecological economists natural capital named not just a subset of inputs into the economy, but a new perspective on the economy as a whole, which was now seen as a sub-system within a global macrosystem of metabolic processes and energetic-material flows. Markets might allocate resources within this sub-system, but the scale of resource extraction and population growth should be determined by extra-economic means (namely centralized government control).[26] The steady-state economy would be a hybrid system that combined centralized control of resource and population levels with markets that would allocate resources within defined limits: Daly suggested that the steady-state economy "might form a future synthesis of socialism and capitalism" (Daly 1980b:367), in which the government would act "as a monopolist" of resources, able to extract "scarcity rent" as "public income" (Daly 1971/1980c:339). Minimum and maximum caps on income would achieve a level of wealth redistribution that would maintain political consensus (Daly 1986/1999:109). These coercive and paternalistic techniques would be combined to produce a political and economic compromise in which unions would be rendered obsolete and strikes would be outlawed (Daly 1986/1999). In other words, the steady-state economy described by early ecological economics (and, as explored in the next chapter, in *The Limits to Growth*) was a reactionary concept: in recognizing the breakdown of the political-economic equilibrium centered on the "Keynesian pact"

[26] Daly argued that, while markets might govern the distribution of resources within the economy, they could not be relied on to determine the "optimal scale of the economy (where scale is understood as the product of population times per capita resource use)" (Daly 1986/1999:109).

between labor and capital (Adamson 2012), it sought to reestablish this equilibrium on a global scale while delinking it from the politics of growth (see also Chapter 3).

In 1967 John Krutilla, an economist at Resources for the Future, introduced a new dimension to the debate on economic growth. Krutilla (1967:778) wrote that even if "those who take an optimistic view would hold that the modern industrial economy is winning its independence from the traditional natural resources sector to a remarkable degree," such arguments did not account for deterioration in the "quality of the natural environment," including "landscape, air, and water quality." This implied a new role for conservation economics, he argued: beyond ensuring the availability of resources to future generations, it must also concern itself with "the problem of providing for the present and future the amenities associated with unspoiled natural environments, for which the market fails to make adequate provision." Krutilla (1967:779) argued that "[w]hen the existence of a grand scenic wonder or a unique and fragile ecosystem is involved, its preservation and continued availability are a significant part of the real income of many individuals," specifically those "spiritual descendants of John Muir… and others to whom the loss of a species or the disfigurement of a scenic area causes acute distress and a sense of genuine relative impoverishment."

While Krutilla never used the term ecosystem services, his paper is now treated as a landmark in the modern formulation of the concept, providing the basis for the contemporary notions of existence values, non-use values, and of recreational and aesthetic 'services' (Kenneth Arrow, quoted in "John Krutilla" 2003; Gomez-Baggethun 2010). Environmental economist Paul Portney (1994:4) called Krutilla's piece "arguably the most influential paper ever written" in environmental economics. Consistent with

Becker's analysis of human capital, for Krutilla the satisfaction derived from, in this case, the mere existence of a natural wonder can be understood as a kind of immaterial income. This idea was further developed by Herman Daly,[27] who defined the term "service" as a general "psychic income", referring (tautologically) to the "satisfaction experienced when wants are satisfied" (1980c:326). For Daly, this idea offered a solution to the problem of growth in a steady-state economy: he wrote that while capital stock and material "throughputs" – in short, "low-entropy matter-energy" – should remain at a steady state, "service" – constituting the "final benefit of all economic activity" – should be maximized, and might grow with increased efficiency. Or as Georgescu-Roegen (1973/1980a:54) put it, within the steady-state economy growth would be in the "true economic output of the economic process… an immaterial flux: the enjoyment of life."

In other words, in this literature 'service' named a capacious category referring to the subjective benefit arising from any life activity, which could, in line with Becker's analysis of human capital, be conceptualized as a kind of income. On the one hand, this suggested that economics analysis pertained to a much broader field of social behavior and decision-making than simply those preferences expressed in markets (see Chapter 4). By suggesting that the aesthetic enjoyment of nature constituted a form of 'income,' Krutilla's early iteration of ecosystem services registered a resurgence of environmental values held, in his words, by the "spiritual descendants of John Muir," which demanded recognition within economic analysis. Thus we might say that the historical conditions of Krutilla's paper were rooted in both the unprecedented transformation of landscapes accomplished during the accelerated industrialization of the 1950s and 1960s, and the

[27] While Daly's invocation of the notion of "psychic income" reflected Becker, he took this idea from the earlier work of Irving Fisher (see Daly 1980c).

environmental movements that contested these devastations. At the same time, it suggested a new understanding of growth, one starkly opposed to economic growth as measured by GDP: as Daly (1980a:6) wrote, "Economists could continue to maximize value, and value could continue to grow forever, but the physical mass in which value inheres must conform to a steady state."[28] Like the notion of human capital, the emerging notion of natural capital offered both an analytic framework for evaluating subjective behavior in utility-maximizing terms, and an alternative explanation of productivity and growth (or decline) at the macroeconomic level.

This understanding of 'services' intersected with another, very different definition of ecosystem services rooted in ecological science. In 1977, ecologist Walter Westman (1977:960) reflected that "policy-makers in Western societies have increasingly asked the monetary value of items and quantities formerly regarded as priceless: clean air and water, untamed wildlife, wilderness itself." But whereas these studies had primarily considered environmental damages to static quantities of resources, Westman distinguished between the goods provided by ecosystems and the functions that underpinned their 'services,' arguing that the latter had only begun to be considered in cost-benefit analyses:

> Ecologists traditionally speak of natural ecosystems in terms of their structure and functions. The structure of an ecosystem includes the species contained therein, their mass, and their arrangement. This is the ecosystem's standing stock – nature's free "goods." From the structural aspects of ecosystems, society reaps two kinds of benefits: (i) the direct harvest of marketable products (for example, fish, forest products, minerals) and the procurement of the genetic resources of valuable species (for example, crop and

[28] The steady-state economy thus involved a transition to a post-industrial mode of growth, in which 'services' are maximized, while costs – or material throughputs – are minimized (Daly 1971/1980b:325). This idea was echoed by *The Limits to Growth* (Meadows et al. 1972:163; also Daly 1980a:22).On the Club of Rome's relation to the critique of growth, see Golub and Townsend 1977.

timber plants, animals for domestication), and (ii) the use and appreciation of ecosystems for recreation, esthetic enjoyment, and study.
The functions of an ecosystem, on the other hand, are characterized by the ways in which the components of the system interact. They are the dynamics of ecosystems – nature's free "services." These functions impart to society a variety of benefits. They include the absorption and breakdown of pollutants, the cycling of nutrients, the binding of soil, the degradation of organic waste, the maintenance of a balance of gases in the air, the regulation of radiation balance and climate, and the fixation of solar energy – the functions, in short, that maintain clean air, pure water, a green earth, and a balance of creatures; the functions that enable humans to obtain the food, fiber, energy, and other material needs for survival. (Westman 1977:961)

Whereas, for Daly (1980c:327), the term "ecosystem services" was simply a way of differentiating the source of some services from others, for Westman nature's services named the *relational* capacities that emerge from the complexity of ecological interactions, which could not be accounted for through conventional summations of "standing stocks" of resources (Westman 1977:963). Westman thus draws a clear distinction between the types of aesthetic and recreational services discussed by Krutilla (which for Westman are an index of ecosystem "stock") and what we might call the *infrastructural* services provided by ecosystem functions. If the discourse of social services aimed to capture the collective capacities of labor and the organizational functions of management as they affected productivity, ecosystem services here describe the relational capacities of ecosystems to regulate the energetic and material flows that underpinned economic life. Measuring their economic contributions, Westman argued, required new metrics and new ways of evaluating complex and changing social values:

Evaluating the contribution of ecosystem functioning to human welfare is a complex task. It is a task of weighing human social values and is the quintessential task of politics… A full range of evaluation techniques, including but not limited to the use of economic measures, then awaits the planner in weighing the social value of benefits and costs. (Westman 1977:963)

It was the intersection of this biophysical understanding of ecosystem function as a kind of infrastructural support for social life with the more general reframing of economic activity in terms of services that defined the emerging concept of ecosystem services. In this way, the early literature contended with two distinct but interrelated problems: on the one hand, it responded to the failure of existing strategies of resource management and to ensure the reproduction of ecological systems and environmental products. In other words it registered the failure of the Keynesian-Neoclassical paradigm that relied on an understanding of the environment as an infinite source and sink. On the other hand, it sought to contend with a broader shift in social values evident in the environmental movement and in the growing critique of consumer society. In a moment when economists such as Gary Becker were expanding the purview of economic analysis beyond the mechanisms of exchange to analyze the internal rationality of human preferences and behavior, environmental and ecological economists made a parallel move, aiming to account for environmental preferences in an expanded economic paradigm.

The tension between these two dimensions of ecosystem services was explored by ecological economist Roefie Hueting (1974/1980) in an expansive book building upon his work in the Dutch Central Bureau of Statistics since 1967. Hueting described a "new scarcity" characterized by competing uses of "environmental functions," such as the use of an ecosystem as a repository for toxic waste and its use in the provision of clean water. Accounting for these functions and their losses, he argued, required a wholesale reassessment of the subject matter of economics, away from the "productivist" bias in economic theory that prioritized growth as measured by GDP. Instead, in a logical

extension of the subjective theory of value inaugurated with the marginalist revolution, Hueting (1974/1980:6) argued that economics was at its base a science of maximizing welfare under conditions of scarcity. However, the problem of valuing environmental functions posed challenges to this subjective theory of value:

> [W]e call the possible uses of the environment for man functions. The latter correspond in part to the concept usefulness as it is employed in economics: the capacity of a good to be desired. Behind this usefulness there lies in turn the objective value in use: the ability of a good to bring about an effective result, whether that result is desired by man or not. (The satisfaction of wants that is ultimately evoked is called the utility.) Now, one difficulty is that some vital functions of the environment are not appreciated by people because they do not know how important these functions are to life on earth (including human life). Consequently, the functions do not fully coincide with usefulness; in part they coincide with the objective value in use… This harm to the environment will probably bring about a reduced satisfaction of wants in the future, but this does not make its effect felt on the present valuations made by people. That is why usefulness gives nothing to go on and why the value of environmental functions cannot be based on the actual wants felt. This circumstance forms a serious methodological stumbling block in the path to quantification of the value of the environment. (Hueting 1974/1980:95-96)

For Hueting, the importance of the new scarcity came not only from objective environmental problems (which he suggested had long existed, even if their scope and intensity had radically increased), but from a social transformation of values expressed in the mobilizations of new social movements. Describing environmental action groups and the student movements that "occasionally invoke the ideas of Marcuse," Hueting (1974/1980:44) wrote: "Although in my opinion it is certain that the behavior of the action groups demonstrates a change in valuation by the public – more preference for the preservation of nature and less preference for an increasing real income in the traditional sense of the word – the quantification of this shift in values encounters theoretical difficulties." These difficulties, Hueting reflected, arose from the fact that the critique of commodity culture was a critique of existing preferences by way of an opposition to the "whole social context," insofar as it "does not proceed from what people actually want,

but from what they would want if they were free…" (44). Because welfare economics by definition does not concern itself with the problem of whence preferences arise but only with the relative quantities in which they are expressed in market values, a preference for the wholesale overhaul of the socio-economic structure of preferences is not comprehensible within this framework. In this way, Hueting acknowledged, the effort to quantify environmental values pushes economic theory to its limits, requiring that it account for values that by their very nature resist measure.

The early notion of ecosystem services registered both the countercultural movement (in terms of a shift in 'preferences' which must be accounted for) and the newly-consequential recalcitrance of nonhuman natures (their inability to be freely appropriated), and articulated the challenges posed to economic thought by these new realities. But these were not simply academic questions. The problem of how environmental functions might be valued and rationally exploited gained salience in the context of broader concerns over the global distribution of manufacturing and the changing shape of the international economic order. This geopolitical dimension has remained unacknowledged in intellectual histories of ecosystem services, but it provides crucial insight into the political stakes of the environmental question in that moment, showing that conceptual debates around the value of nature in the 1970s were inseparable from geopolitical relations and the changing geographies of production and trade. By revealing an unrecognized history of the concept of ecosystem services, it demonstrates that the political uses to which this idea might be put were not predetermined in the 1970s, but presented an open (geo)political problematic.

Stockholm 1972: The geopolitics of infrastructural nature

The 1972 UN Conference on the Human Environment in Stockholm was, in many respects, the culmination of the environmental movement as it had taken shape in the 1960s. The first major intergovernmental conference on environmental issues, it brought environmental politics to the center of ongoing debates over uneven development, Third World resource sovereignty, and the shape of a possible New International Economic Order, "put[ing] on display for the first time the central tension which has dogged global environmental discussions ever since," between the development needs of formerly-colonized nations and the environmental concern of rich countries (Brenton 1994:27; see also Chapter 2). Outside of the contentious debates over the divergent meanings of environmental problems within First, Second, and Third World nations, the conference itself was a microcosm of the environmental movement more broadly. Thousands of Leftist activists, eco-lifestyle groups, birth control advocates, and hippies converged at the counter-conference, dubbed "Woodstockholm" by American news media (Scott 2016). Alongside (and in tension with) the confrontational tactics of Left activists in the People's Forum and other groups, Stewart Brand (the founder of the Whole Earth Catalog) saw the conference as an unprecedented advertising opportunity for his particular brand of hippie-libertarian lifestyle politics, helping to bring members of Wavy Gravy's Hog Farm commune to set up shop in Stockholm as a living "model of environmental living," complete with refurbished buses (David Zwerdling, quoted in Scott 2016:115).

But if the conference delegates were effectively insulated from the antics and demonstrations of the counter-conference, their negotiations were shaped by these

movements in less direct ways. A key topic of concern among nations was the impact of environmental movements and subsequent environmental regulations on the global distribution of production and trade. In the lead-up to the event, the conference secretariat convened a meeting of Third World scientists and development experts at Founex, Switzerland in June 1971. That event, followed up by a series of regional meetings throughout the summer and fall of that year, generated one of the conference's most significant documents (Rowland 1973:48). The Founex Report expressed Third World nations' recognition that environmental issues constituted a consequential set of political forces, whose implications were yet to be determined:

> Environmental issues may come to exercise a growing influence on international economic relations. They are not only a formidable competitor for developed countries' resources (which in some instances might have been channeled towards development assistance), but they are also a factor which, to an ever-increasing degree, could influence the pattern of world trade, the international distribution of industry, the competitive position of different groups of countries, their comparative costs of production, etc. Environmental actions by developed countries may have a profound and manifold impact on the growth and external economic relations of developing countries (Adamovic et al. 1972:8-9).

In that document and the subsequent negotiations in Stockholm, developing nations strategized about how environmental issues might best be mobilized in their interests. On the one hand, increasing environmental concern in developed nations threatened to justify restrictions on resource-intensive import commodities, whereas an increase in recycling might affect demand for raw materials (Adamovic et al. 1972:9; Rowland 1973:50; UN 1972:82). The Founex report speculated on the implications of environmental concern in developed nations for demand for primary commodities, drawing a parallel between environmental and labor exploitation: "The humanitarian concern for the environment can far too easily become a selfish argument for greater

protectionism. The developing countries still confront the argument of 'sweated labour': the argument of 'sweated environment' will be equally fallacious but even harder to beat" (Adamovic et al. 1972:30). In the conference, developing nations called out the hypocrisy of rich countries whose industrialization had been built on the expropriation of cheap nature from the colonies, and argued that those natures would not remain cheap in the future.[29] On the other hand, however, the report acknowledged that the rhetoric of global interconnection on the part of rich nations cut both ways: "An emerging understanding of the indivisibility of the earth's natural systems on the part of the rich nations could help to strengthen the vision of a human family, and even encourage an increase in aid to poor nations' efforts to improve and protect their part of the global household" (Founex Report, quoted in Rowland 1973:73).

Part of these debates over the political and economic significance of First World environmental concern was a relatively novel idea: the notion that developing countries might exploit the "pollution absorption capacity" of their environments as a comparative advantage to attract investment in heavy industry. The Founex Report states that the question was "considered at some length" at the meeting, and that "this whole subject bristles with controversies" (Adamovic et al. 1972:35). The final report called for enhanced research and knowledge production on environmental carrying capacity and impacts, and for developing countries to enact environmental policies that would balance industrialization with basic environmental protections (26-27). The topic was raised at Stockholm in the conference's working paper on the topic of environment and development, which argued that:

[29] On cheap nature, see Moore 2015.

> The capacity of the natural environment to absorb and dissipate waste without suffering intolerable damage must now be regarded as an economic [rather than a 'free'] resource. Since the less industrialized countries have by and large put lighter burdens on their environmental resources than the industrialized countries and may therefore be able to afford less stringent environmental standards, this could give them a comparative advantage in the establishment of certain new industries… In order to avoid the indiscriminate import of pollution, developing countries could enforce environmental standards to achieve minimal levels of industrial pollution in the light of their stages of development and of their cultural and social objectives." (quoted in Rowland 1973:70)

The paper recommended careful consideration of this issue by developing nations, and that the UN Secretary General actively help developing nations seek out relevant opportunities for the rational exploitation of their environmental resources (Rowland 1973:71). In his history of the conference, Wade Rowland (1973:71) reflected that, "[c]onsidering the almost revolutionary nature of this argument — that industry might be distributed throughout the world in a coherent manner which would take more account of is impact on the local environment than of its ownership — many observers at Stockholm were surprised when it passed the final plenary stage easily, by a vote of 65-0-8, with the US prominent among 8 abstentions." The issue was not without debate: the Ghanaian delegation warned in committee meetings against the dangers of industrial "dumping" on developing nations, while deforestation in Brazil was raised as an example of the danger faced by developing nations who failed to enact adequate environmental standards (71). The problem at hand was however not how to avoid pollution altogether, but what new kinds of knowledge, expertise, standards, and legislation might be required to rationally exploit environmental capacities in ways that would promote rather than denigrate the health of populations. Among the conference's recommendations, the issues of knowledge transfer around the environmental impacts of industry and capacity building in developed countries in the areas of environmental research and monitoring were

prominent. The issue was explicitly addressed in the recommendation that "Governments of the developing countries consider fully the new opportunities that may be offered to them to establish industries and/or expand existing industries in which they may have comparative advantages because of environmental considerations, and that special care be taken to apply the appropriate international standards on environment in order to avoid the creation of pollution problems in developing countries;" and further, "[t]hat the Secretary-General, in consultation with appropriate international agencies, undertake a full review of the practical implications of environmental concerns in relation to distribution of future industrial capacity and, in particular, to ways in which the developing countries may be assisted to take advantage of opportunities and to minimize risks in this area" (UN 1972:27, rec. 106).

In these discussions, the problem of pollution was defined not as an absolute despoilation, but as a rational exploitation of the Earth's limited waste processing functions, which were unevenly distributed geographically due to political-economic and biophysical difference. The question of how developing countries might use this pollution absorption capacity as an economic resource was not only taken up in the conference, but was discussed in a growing body of business literature that reflected on the implications of environmental regulations in First World countries on geographies of production and trade (e.g. Agarwal 1976; Walter 1972; Quigg 1972; Welles 1973). For instance, for economist Jamuna Agarwal (1976:1), the "air, rivers, oceans, sun energy, climate and other environmental constituents which determine nature's absorptive capacity for industrial growth and pollution"[30] constituted a new category of natural resources,

[30] Agarwal included in this definition the tourist value of landscape and climate, but noted that "investment in tourist attractions require a different treatment than those in the remaining

defined as “environmental resources” distinct from “exhaustive” resources such as minerals, fossil fuels, and even timber. As Agarwal (3) wrote,

> Environmental resources are, contrastingly [to exhaustive resources], available in every country and cannot be regarded as economic goods so long as manufacturers have to pay no or relatively negligible prices for using them either as inputs or as means of waste disposal, excessive heat emission, etc. However, user costs for environmental resources in developed countries are now increasing because of both the scarcity of suitable factory sites and the pollution control. This trend is very likely to continue in the future making the environmental resources of developing countries attractive for the manufacturers from developed countries.

Agarwal argued that the trend toward increased sovereign control over exhaustive resources and the nationalization of extractive sectors in developing countries had decreased the attractiveness of these sectors to foreign capital. Due to their need for foreign capital investment, Agarwal argued, developing countries needed to create attractive conditions for investment in their environmental resources. Such investment depended not only on lax pollution control, but also on competitive wage levels, capital markets, conciliatory attitudes toward foreign capital, insurance, and the availability of complementary inputs, among other factors (Agarwal 1976:18). Exploiting the value of a country’s “pollution absorption capacity” therefore required a whole host of policy reforms designed to attract foreign capital (3-4).

> Protectionist policies and oligopolistic structures can resist the free market forces and have so far largely succeeded in hindering an industrial spill-over from the developed to developing countries, but they may not be able to cross the natural barriers set by environment to geographical concentration of industrial growth. The environment is likely to prove a major force in bringing about a broader distribution of industrial production between the developed and developing countries evoking some fundamental structural adjustments in the former. (Agarwal 1976:21)

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environmental resources needed by manufacturing industries and it is only these latter type of resources which are referred to when the term environmental resources is used in this paper” (p. 2, note 1).

For Agarwal, as for the nations convening in Stockholm, the environment named a set of political forces that might be oriented toward a "relative equalization of factor prices and income levels between the nations" (21); it could work in the interests of free trade and against the protectionist policies of developed countries, if developing nations were to establish rational and strategic environmental policies. A concept of nature's infrastructural services was central to this understanding. It was by rationalizing the limited waste processing functions of ecosystems, conceptualized as a limited "pollution absorption capacity," that developing countries could pursue environmental exploitation without excessive despoilation:

> The environment has an inherent power to absorb industrial pollution and regenerate itself within certain limits. Only beyond these natural limits the 'trade off' between industrialization and environment poses a serious problem for pollution prevention and control… [Developing countries] stand to gain from the flow of foreign capital into their environmental resources as long as the social costs of environmental degradation do not exceed the social benefits resulting from these investments and should be prepared to exploit nature's assimilative capacities for their economic progress. (Agarwal 1976:20)

As another commentator remarked, echoing colonial-era environmental determinisms, these capacities resulted from an intersection of biophysical and economic conditions that might work to the advantage of developing countries:

> In most developing countries the threshold beyond which the eco-system can no longer absorb industrial effluents is still far removed, and the effects of environmental degradation are frequently less marked. Hot or dry climates tend to minimize the impact of certain effluents of production processes. High rainfall levels reduce the impact on air quality of certain types of emissions. Low population densities reduce the effects of other types of pollution, and large undeveloped tracts of land render marginal encroachment by industry of minor significance… As a result, with the marginal social benefit even of pollution-intensive industries exceeding their marginal social cost in the developing countries, one would expect them to welcome investment in these sectors, even at some cost to the environment. (Walter 1972:95)

These discussions anticipated the use of "pollution havens" by multinational corporations, but framed this as a rational strategy that developing nations might promote

in their own economic interest.[31] The understanding of pollution absorption capacity made visible a whole spectrum of ecological activity and environmental features (undeveloped tracts of land, areas of heavy rainfall, deserts, etc.) whose economic potentials were being wasted, and which might represent new sources of value. Exploiting these resources (or turning them, in Moore's [2015] words, into a new "abstract social nature") required new research into the nature and limits of ecosystem capacities (see Chapter 3), and new techniques of measurement and policy that would enable these capacities to be rationally accounted for and utilized. In this literature and at Stockholm, the environment was addressed not as an inert object subject to human impacts, but as a set of productive capacities whose potentials and limits demanded new kinds of research and new metrics of productivity and growth. The question of how to use these capacities opened onto a set of political problems relating to the nature of economic growth and development, the sovereignty of developing nations vis-á-vis their environmental resources, the global distribution of industrial production, and the implications of First World environmental movements for international economic relations. These debates engaged with the concept of infrastructural nature as a practical problem that was central to the project of remaking the international economic order.

Conclusion

Revisiting early debates over ecosystem services reveals that the concept did not emerge solely through the efforts of ecologists such as Gretchen Daily and Paul and Anne Ehrlich to communicate with economists in the 1980s and 1990s. Rather, its defining

[31] Agarwal cites Barnet and Müller's use of this term in their influential 1973 book, *Global Reach: The Power of the Multinational Corporations*. However Agarwal concludes that there is "no reliable evidence" that foreign investment in manufacturing in developing countries is already being motivated by environmental controls (8).

features figure in economic and political debate much earlier. In these early debates, two distinct problems define the emerging concept of ecosystem services: on the one hand, the notion of services gained prominence in the context of broader reorientation of the field of economics, away from a focus solely on mechanisms of production and exchange to a broader analysis of human behavior. As explored further in Chapter 4, the resurgence of environmental concern and anti-consumerism articulated in social movements was engaged as a new set of 'preferences' to be comprehended within the terms of economic rationality. On the other hand, the concept articulated an emerging notion of *infrastructural* nature, in which the capacities of ecosystems to perform productive functions (in this case, to assimilate waste) were conceptualized as an economic resource to be rationally managed and exploited.

As the debates over how to rationalize and exploit pollution absorption capacity illustrate, the environment in the 1970s was not a coherent object of politics, but a set of interlinked political questions – often in tension with one another – concerning the future of industrial capitalism in an era of political and economic upheaval. In that context, the concept of ecosystem services indexed a series of issues that, while interlinked, posed different political and theoretical problems – including the environmental movement and its various implications for geographies of production, for economic theories of value and preference, and for the role of economics in public policy; and the need for new scientific understanding of the biophysical limits to resource exploitation and pollution. The account offered here reveals the non-identity of the term ecosystem services and the concept(s) to which it refers. This changes our understanding of the history and politics of ecosystem services by showing that the tensions and inconsistencies in contemporary

thought on ecosystem services are not only the product of internal disagreements within economic theory (e.g. Dempsey and Robertson 2012), but also stem from the broader political challenges to which thinkers of ecosystem services responded. In particular, I want to suggest that the understanding of infrastructural nature that emerges in this early literature — as distinct from the notion of aesthetic or recreational 'services' — provides a key point of departure for understanding the contemporary politics of ecosystem services, and enables us to place that concept in the context of a much broader shift in which environmental governance increasingly seeks to directly manage and measure the relational capacities of social-ecological systems rather than simply maximizing their final products (see also Chapter 3). As I return to in the conclusion, this suggests a different role for critical scholarship on ecosystem services: rather than focusing on instances of nature's commodification and marketization, we might ask how public and private investment is directed in the production and maintenance of infrastructural nature, what forms of labor are involved in that maintenance, and what kinds of political rationalities and future imaginaries are at work within it. And rather than dismissing ecosystem services programs as inadequate solutions to contradictions of capitalism, we might engage them as instances of political contestation over how, and by whom, the 'work' of social-ecological reproduction will be valorized – contestations which inflect the early literature on the topic and which persist in the present. In other words, moving away from a critique of ecosystem services in terms of its utilitarian origins as a *solution* may suggest a more generative critique of the political possibilities it presents as a *problem*.

Chapter 2: 'Catastrophe or new society?' Global limits and world futures

Growth cannot continue indefinitely on a finite planet... we are faced with an inevitable transition from world-wide growth to global ecological equilibrium.

– Dennis Meadows[32]

Selling close to 10 million copies and translated into 30 languages, the Club of Rome's 1972 report on *The Limits to Growth* was one of the most influential documents in shaping the global environment as a matter of concern (Cooper 2008:15; Elichirigoity 1999). *Limits* catalyzed a formative debate among economists and environmentalists that, in its starkest form, pitted a techno-futurist optimism against a pessimistic environmental conservatism insistent that the finitude of the earth posed an inescapable constraint on political futures. The report became the touchstone for an influential and persistent strain of environmental thought in which the materiality of the planet is encountered in the form of absolute limits to human life, and in which the survival of the human species necessitates a neo-Malthusian environmental austerity.

The Limits to Growth also figures prominently in the history of systems analysis and computer modeling. As Paul Edwards (2010:371) writes in his history of climate modeling, *Limits* helped to "mark the public debut of global simulation modeling as a primary technology of environmental knowledge" (2010:371). This was due less to the model's scientific merits (which many commentators on all sides of the environmental debate found seriously wanting) than to the public relations and advocacy efforts of the Club, and in particular its founder Aurelio Peccei. But *Limits* was not only instrumental in

[32] quoted in Elichirigoity 1999:96.

shaping the emergence of the global environment as a matter of concern; it also helped to inaugurate a new era of global governance strongly shaped by systems science (Edwards 2000). In his history of the project, Fernando Elichirigoity (1999:5, 3) argues that *The Limits to Growth* marks a seminal moment in "the advent of the age of globality," characterized by a "paradigmatic shift, from a world organized around the political space of the nation-state to one organized around the biopolitical space of the whole planet." By linking cybernetics and systems science to the whole earth as an object of management and control, the *Limits* report was formative of a new era of transnational governance concomitant with the neoliberal turn.

But while the history of global systems modeling and its links to global governance are often narrated through its origins in US military and intelligence research (e.g. Elichirigoity 1999; Edwards 2000), less attention has been paid to the project's political history and its imbrication with processes of class formation. In this chapter, I revisit the history surrounding *The Limits to Growth* in order to more fully explore its political origins and implications in the context of economic and political upheaval in the 1960s and 1970s. In doing so I do not aim to provide a history of the project itself (which has been done elsewhere; see especially Elichirigoity 1999; Moll 1991; Edwards 2000), but to highlight two aspects of that history that have been largely ignored: first, focusing on the immediate pre-history of the project through the career of Aurelio Peccei, I show how *Limits* was situated at the intersection of two processes of class formation: on the one hand, the increasingly-international alliance between militant labor and New Left movements; and on the other, the formation of a Transnational Capitalist Class that would be instrumental in advancing neoliberalism on a global scale. Second, by highlighting a

subsequent world modeling project undertaken in response to *The Limits to Growth*, I show how global modeling was mobilized as a political technology to envision radically divergent global futures in the 1970s. Together, these dimensions of the project's political history trouble the notion of a singular lineage of global simulation rooted in military technology, indicating the multiplicity of global modeling's political origins and implications for envisioning environmental futures in the 1970s. At the same time, they show how the production of the global environment as a political problem and object of governance was constitutive of a new era of globalization, and how it was shaped by the class dynamics of the global counterrevolution.

I begin by foregrounding Peccei's career as a top manager at Fiat, to show that the global vision articulated by the Club of Rome was not only an inheritance of military operations research but was equally inflected by Peccei's managerial philosophy and his experience with labor unrest in his factories. In the years leading to the formation of the Club of Rome and through the publication of the *Limits* report, Peccei's position as Chairman of the Board of Fiat Concord in Argentina put him at the center of a militant labor movement that would consolidate the labor-New Left alliance in Argentina and profoundly transform Argentinian national politics. Combined with the parallel mobilization of Fiat workers in Turin, these movements posed a transformative challenge to Fiat management. I bring James Brennan's (1994) detailed history of labor movements in the Córdoban auto sector together with Peccei's writings to show how new forms of resistance shaped Peccei's global vision. Throughout this period of labor unrest, Peccei tirelessly engaged in private international diplomacy aimed at generating high-level political attention to global problems, advocating for paternalistic global management at

the same time that these approaches were under siege in Fiat's factories. The increasingly-global alliance between New Left movements and labor in the late 1960s and 1970s, I argue, haunts the emerging global imaginary articulated by the Club of Rome that became so influential to environmental thought.

Second, I move from this prehistory to examine the geopolitical context in which *The Limits to Growth* gained meaning in the early 1970s. I do so by placing the model back into conversation with its counterpart, a global model developed at the Bariloche institute in Argentina that has been largely ignored in histories of modeling.[33] Published in the report *Catastrophe or new society? A Latin American world model*, the Bariloche model was formulated as "a response from the South" (Gallopín 2001:79) to World3 and the worldview it represented. It demonstrated that the so-called 'limits to growth' were not biophysical but socio-political and economic, and could be transformed by a global transition to democratic socialism. The Bariloche model demonstrates that the political implications of global systems modeling were not predetermined by its militaristic and technocratic origins, but were rather caught up in a broader geopolitical struggle over how and by whom new technologies might be mobilized, and in the service of what possible futures.

This chapter writes a new history of the *Limits* report as a seminal articulation of the environmental crisis theorized in the previous chapter, in which the closed-systems ontology of 1960s ecological imaginary became the basis for re-imagining the global order. In the process, I demonstrate how the emergence of the environment as an object of politics was fully implicated in the transformation of the postwar economic order in the

[33] The project is not mentioned in Elichirigoity (1999), Edwards (2010), or Moll (1991).

1960s and 1970s. On the one hand, by focusing on Peccei's career, we can see how global environmental imaginaries were intimately shaped by the processes of class formation constitutive of the counterrevolution. Insofar as the Fiat plant in Turin was the epicenter of the labor-New Left alliance that gave rise to the *autonomia* movement and its theoretical lineages,[34] this history also intervenes in Virno's narrative to demonstrate the global histories of counterrevolution, as new forms of labor resistance in Italy were matched by equally consequential mobilizations across Fiat's subsidiaries. On the other hand, in the formative years leading up to the formal calls for a New International Economic Order initiated by Third World states in 1973, futurological projects such as *The Limits to Growth* and the Bariloche model were political propositions about the feasibility and desirability of alternative global futures. Debates over the nature of environmental problems and their solutions were also debates about the structure of the world system and the position of Third World nations in that system.

In contrast to existing histories of *Limits* that situate the project within the technical history of global modeling, this chapter shows how *The Limits to Growth* opens up a different history of environmental futures in the 1960s – one that draws a circuit between the global terrain of labor struggle and that of international geopolitics. In this way it reveals paths not taken in the restructuring of the global economy after the 1970s, including Peccei's vision of paternalistic global management; the international egalitarian socialism envisioned in the Bariloche report; a New International Economic Order in the interests of Third World self-determination; and a global revolution accomplished by

[34] On the evolution of the 1970s *autonomia* movement from previous *operaist* ('workerist') organizing and scholarship centered on Fiat factories, see Wright 2002 and Berardi 2007.

labor and New Left movements. These alternative globalisms constitute the "future histories" (Virno 1996) that persist within neoliberal globalization.

The future of the multinational corporation in the 1960s and 1970s

Perspectives or eschatologies have a way of becoming self-fulfilling prophecies.

– Sidney Rolfe[35]

The economic and political instabilities manifest in the environmental crisis, discussed in Chapter 1, created the historical conditions for the global perspective articulated in *The Limits to Growth*, and for its reception on a broad scale (Golub and Townsend 1977). The challenges posed to US economic and monetary hegemony, which had been the basis of the postwar international system, were felt on a number of fronts: currency trading in unregulated 'Eurodollar' markets threatened the stability of the dollar as global reserve currency, prompting Nixon's 1971 closure of the gold window (Arrighi 2010); US military expenditures to combat Third World communisms (especially in Vietnam) precipitated both a balance of payments deficit and an ideological crisis (Magdoff and Sweezy 1972); and a declining rate of profit in US manufacturing, alongside industrial recovery in Europe and Japan, transformed the geography of production and competition. These developments would come to a head in 1973-4, when the 'oil shock' precipitated by OPEC's price hike was transformed by the oil and gas industry into an 'energy crisis' (Mitchell 2012; Golub and Townsend 1977).

In the 1960s, a major development in the context of these emerging instabilities was the rise of multinational corporations (MNCs) as a driving force of globalization. The

[35] In Rolfe 1970:5.

internationalization of capital facilitated by MNCs politicized international business relations, as the power of MNCs abroad was encountered as a projection of national state power.[36] In the process it also created a conflict between the state's function to ensure equal competition and its role in supporting national capital overseas, such that restoring competition required new international regulatory controls (van der Pijl 1993:29). As van der Pijl (1993:30) writes, "the question of whether the… necessary regulatory structures, which on the national level are summarized in the capitalist state, could be reproduced on the international level without succumbing to the trend of bureaucratization and democratization then under way, was entirely open in the 1960s." At stake in this question was the sovereignty of capital relative to public institutions, or the degree to which international regulatory structures would be determined by and in the interests of international capital.

Central to these concerns over the role of multinational firms in shaping the new world economy was the economic and political status of the Third World in the international system. Due in part to impact of MNCs on the ability of national governments to control natural resources and monetary stability, the crisis of US political, economic, and monetary hegemony was also a crisis of the system of dependency between developed and underdeveloped countries that had guaranteed the latter's status as the source of cheap inputs obtained on exploitative terms of trade (Golub and

[36] As Luciano Martíns (1974) writes: "Between 1960 and 1970, North American investments abroad jumped from $31.9 billion to $70 billion; more significantly, whereas US production capacity in manufacturing increased 4.7 percent between 1960 and 1968, in the 'third economy' controlled by multinational corporations it grew at an average rate of 11.5 percent during the same period." This expansion of multinational capital abroad, Martíns notes, was coincident with a withdrawal of direct political intervention. Martíns argues, however, that this was an expression of a growing conflict between US national and economic interests rather than a national political strategy.

Townsend 1977:214). This crisis was expressed in part by what David Rockefeller described as a "growing spirit of independence in Latin America," evinced in a wave of nationalizations of formerly US-owned companies and other exercises in national sovereignty over foreign capital in some Latin American countries (quoted in Martíns 1974:370). By the early 1970s, catalyzed in part by the role of MNCs in destabilizing the Allende government in Chile, the problem of regulating multinational capital would become a major topic of concern in the UN. Just as MNCs were emerging as a primary force of globalization, their very operations were undermining the institutions and geopolitical relations that had enabled their growth.

Van der Pijl (1993:31) argues that one version of this regulatory drive was expressed by an emerging managerial or "cadre class," whose influence and interests were shaped by the "international socialization of the productive forces" through MNCs. He argues that the rising social democratic movements in the 1960s, especially in Western Europe, stemmed primarily from the interests and growing power of this managerial class (rather than from the established left), for whom the stability and equilibrium in the global economy was a primary concern. The cadre class was "oriented toward the state as the privileged arena for imposing on the actual working class the 'equilibrium of compromises' through which the capitalist class rules in modern capitalism" (van der Pijl 1993:34). In other words, for this managerial class the maintenance of the "Keynesian pact" (Adamson 2012) between labor and capital through a state apparatus capable of ensuring stability was a more pressing concern than the "orthodoxy of the market mechanism" (van der Pijl, quoted in Carroll and Sapinski 2016).

Club of Rome founder Aurelio Peccei, one of an emerging contingent of global mangers at the forefront of the 'cadre class,' was a visionary figure in this new field of corporate futurology (a contemporary commentator described him as one of the "philosophers of the multinational corporation" [Modelski 1972:407]). In histories of the Club of Rome and the *Limits* project, Peccei has been hailed as a pioneer of an emerging global consciousness (Elichirigoity 1999; Pauli 1987). In order to understand Peccei in his historical context, however, we should neither see his global vision as the result of a unique individual genius nor as a passive symptom of his class position. Instead, we might see Peccei as an innovator who linked systems analysis and computing, ecological notions of equilibrium, and his own management philosophy to formulate a response to emergent problems whose global character exceeded the control of existing governance institutions.[37] For Peccei, this activity of recombining existing techniques and technologies in the face of urgency was precisely the function of a manager, "whose business is mainly that of deciding how ideas, facts and resources may be compounded into action, or preparation for action" (Peccei 1968:517).

In 1968, Peccei and Club of Rome co-founder Alexander King organized an OECD conference on Long-Range Forecasting and Planning that brought leading cyberneticists and systems theorists such as Stafford Beer, Hasan Ozbekhan, Jay Forrester, and Erich Jantsch together with corporate managers and business professors. The Bellagio Declaration on Planning that emerged from that conference linked the

[37] Here I follow Collier's (2009) reading of Foucault's later lectures, in which Collier argues that significant thinkers "are situated precisely amid upheaval, in sites of problematization in which existing forms have lost their coherence and their purchase in addressing present problems, and in which new forms of understanding and acting have to be invented" (95). This is explored further in Chapter 3.

increasing complexity and politicization of the multinational firm to the need for international coordination:

> In the corporate environment, the individual enterprise tends to become larger and more complex. Multinational industrial activities are developing which can be expected to influence increasingly [the] political relationships between the nations. This necessitates international planning (Bellagio 1968:7).

For Peccei and his compatriots, the effort to *forecast* global futures was inseparable from the effort to *manage* those futures through "the 'new' planning," capaciously defined as "the purposeful, rational goal-oriented conducting of human activity" (Peccei 1968:518). Quoting Jantsch, Peccei (1969:225) wrote that "one may even 'discern a "natural" trend to fuller and fuller integration of forecasting and planning so that in the 1970s the technological forecasting function may be increasingly "dissolved" into the planning function.'" Futurology was therefore a key field of research in which the problem of the sovereignty of capital vis a vis an emerging international regulatory system played out. In 1969, Peccei chaired a conference of the Committee on Atlantic Economic Cooperation that sought to give voice to corporate futurological "perspectives". In the proceedings of that conference, economist Sidney Rolfe highlighted the importance of corporate involvement in shaping global futures:

> A perspective view is being sought not only at the meeting from which this volume arose but in the numerous university, research, governmental, and other inquiries now under way. It is essential that businessmen should give at least as much thought to this question as other establishments do… A new world economy is taking shape, largely as a result of the internationalization of production – or as one French writer has phrased it, 'planetisation.' Its ultimate shape is yet unknown… And that shape will in turn depend on the vigor and persuasiveness of those now seeking perspectives. International business can help to shape that future: If it remains passive and provincial in its view, it will simply be shaped by the vision of others, perhaps less qualified" (Rolfe 1970:5-6).

Peccei viewed the Club of Rome's foray into futurology via *The Limits to Growth* as a crucial step toward the new science of long-range planning, and as part of a broader

effort to advance new institutions of international coordination that would circumvent what he saw as the cumbersome inefficiencies of democratic process within the UN. In this light, *Limits* might be understood not as an essentially environmental text, but as a seminal entry in a growing field of corporate-driven futurological research. This literature brought together corporate desires for institutions capable of re-establishing equilibrium and stability in the global economy with an emerging field of futurology rooted in the new sciences of systems analysis and computing, giving rise to a proliferation of attempts to envision the key trends that would shape global futures (e.g. Jantsch 1968; Rolfe and Damm 1969). As Golub and Townsend (1977:210) have argued, it was MNCs in less-powerful countries (such as Italy) whose interests were most threatened by the economic instabilities of the 1960s, and who stood to benefit most from a new system of international control. The global institutions necessary to govern the types of 'macroproblems' articulated by the Club of Rome were also those that might provide the stability of prices, access to raw materials, protection from excessive competition, and coordinated economic policies that would "[ensure] that the market remains orderly" (Hugh Stephenson, quoted in Golub and Townsend 1977:209).

But following Peccei's career does not simply enable us to understand *The Limits to Growth* as the product of a particular corporate agenda. More significantly, it enables us to see how that agenda, and the environmental imaginary it generated in *Limits*, was shot through with the shop floor struggles taking place in Fiat's Argentinian factories. It was Peccei's direct management experience in the context of competitive pressures in the Latin American auto sector and the perpetual upheaval of Argentinian politics that shaped his unique approach to global problems. Through his professional activities and his

tireless political advocacy, Peccei provides a conduit between the 'local' politics of the Argentinian labor movement and the 'global' geopolitics of the new international economic order in the 1970s. That is, his career enables us to see the alliance between militant labor and the New Left in Argentina as a formative force in the conceptualization of the world 'problematique' and the Club of Rome's response, which sought to establish a new regime of 'global management' at the precise moment when management was being thrown into crisis on the shop floor.

Aurelio Peccei in Latin America: Management against revolution

"*[T]he new world organization calls for an exceptionally good and efficient management*. The alternative would be disruption and chaos on a colossal scale."

– Aurelio Peccei, 1969[38]

Peccei's career at Fiat, beginning in 1927 as part of the Special Projects Division, was characterized by a commitment to globalizing the company's operations in the context of continual social and political upheaval. After early work to expand Fiat operations in the USSR, in 1935 Peccei worked with the Chinese government to establish manufacturing facilities for Italian airforce planes in that country, a project that was soon shaken by the Japanese invasion and the simultaneous mobilization of "bandits" in the south who would become Mao's revolutionary army (Pauli 1987:15-16;19). When the Italian-Japanese alliance forced him to return to Italy in 1937, Peccei joined the liberal anti-fascist group Giustizia e Liberta, even as Fiat leadership aligned itself with Mussolini's governmen. Peccei spent much of the war working for the resistance while traveling on company business (Pauli 1987:23-24). Arrested and tortured by the fascist militia in 1944, his allegiance to the resistance won him an appointment as Commissioner

[38] In Peccei 1969:278; original emphasis.

at Fiat in 1945, when the company was taken over by the National Liberation Committee. In this position he was instrumental to rebuilding the decimated company in the aftermath of the war (Pauli 1987).

Seeking to once again expand Fiat's operations abroad after the war, Peccei urged the company to keep a close eye on Argentina (Pauli 1987:32). Fiat had established commercial operations in Buenos Aires in 1919 (Goldstein and Lluch 2010:16), and the opportunities presented by Argentinian industrialization looked even more attractive in stark contrast to postwar Italy. Peccei saw the rise of Juan Perón in 1946 and his ambitious industrialization agenda as "the opportunity for which [he] had been waiting" (Pauli 1987:33; Goldstein and Lluch 2010: 21-23). Attracting skilled foreign immigrants was "[o]ne of the pillars of Perón's plan for revitalizing the Argentine economy," and he was especially welcoming to Italian entrepreneurs (Goldstein and Lluch 2010: 21).
In 1949, Fiat finally heeded Peccei's requests and dispatched him to Argentina (Goldstein and Lluch 2010:23; Pauli 1987:33). Drawing on his experience in China, Peccei arranged a technical agreement with the air force to establish a tractor manufacturing facility (Pauli 1987:34-5). Convinced of the strategic necessity to bring business plans into line with government development agendas, Peccei drafted a five-year plan for Fiat that was closely aligned with Perón's own five-year plan for the Argentine economy (Pauli 1987:34). In negotiations lasting several years, Fiat managed to exploit the weaknesses of the Perón government and secure beneficial terms for its projects, acquiring the tractor facility virtually at cost while securing protection from foreign competition (Brennan 1994:30-31). The tractor factory became the basis for the new company Fiat

Construcciónes Córdoba – or Fiat Concord – and marked the beginning of the Ferraya industrial center in Córdoba (Pauli 1987:35).

As James Brennan (1994) writes in his history of labor politics in Córdoba, the automotive industry in that city was the heart not only of Perón's and subsequent governments' modernization policies, but also of a new industrial proletariat that would become a powerful and decisive figure in Argentine national politics. Perón's consolidation of and control over the labor movement would define the "peculiar genius" of his populism, while also laying the groundwork for the explosive workers' mobilizations in the 1960s and 1970s (Brennan 1994:7). The Fiat plant at Ferraya, alongside the American-operated and state subsidized Industrias Kaiser Argentina (IKA), would form the center of this emerging industry and its transformation of Córdoba into an "Argentine Detroit," where shop floor struggles permeated urban culture and politics (44).

With the fall of Perón in 1955, the significance of the industry and the extent of its control by foreign capital would only increase. In 1955, the incoming Leonardi administration commissioned a report from Raúl Prebisch, of the Economic Commission on Latin America, on the state of the Argentine economy and prescriptions for its recovery from Perón's economic policies. Peccei participated "behind the scenes" in the drafting of the report, and took advantage of his insider knowledge to lay plans for a second factory in Córdoba – Grandes Motores Diesel – to produce the engines required for the government's industrialization projects (Pauli 1987:35-36). With "practically no competition" for government contracts in these areas, Peccei further expanded with a third factory, Materfer (36). Together, next to IKA, these Ferraya plants "represented the

second largest concentration of manufacturing might and industrial labor in the entire Argentine interior" (Brennan 1994:36-37).

The new regionalism and Latin American economic integration

During his tenure as Chairman of Fiat Concord through the height of the automotive industry in Córdoba (1953-74), Peccei forged his global vision through activities in the Latin American region and abroad that linked international development agendas directly to his work at Fiat. In 1957, Peccei was asked by a group of Italian government officials, industrialists, and financiers to form the international development consulting firm Italconsult. Drawing on his experience integrating investment projects with government objectives, Peccei used the firm to expand opportunities for his own company: his first initiatives were land reclamation projects in Iran and Egypt, through which Grandes Motores Diesel achieved its first exports (Pauli 1987:39). In Latin America, Peccei's activities were unified by an effort to increase opportunities for foreign direct investment and to facilitate regional economic integration through a Latin American common market. He worked closely with Perón and successive Argentine leaders, as well as others in the region (including Brazil, Colombia, Chile, and Venezuela) to spread this vision, while also lobbying for favorable industrial policies and access to lucrative government contracts (Pauli 1987). In the late 1950s he established a research institute through Fiat – the Oficina de Estudio para la Colaboración Económica Internacional – to "study the economic situation in depth and to be in a position to propose ideas to the leaders of the country" (Pauli 1986:48; Goldstein and Lluch 2010:30). The institute's reports outlined a development path involving foreign direct investment, industrialization, and regional economic integration through a Latin

American common market along the lines of the European Economic Community (Goldstein and Lluch 2010:30; Pauli 1987:50). Armed with OECEI case-studies of Fiat, Peccei "travelled throughout Latin America in order to make it clear that Fiat, for one, would invest along the lines laid out in the study, if the countries would co-operate and attempt to set up a common market" (Pauli 1987:50).

Peccei's agenda for Latin American economic integration gained further influence in connection with US foreign policy interests in the region. In the early 1960s, Latin America was a primary economic and ideological battleground in the Cold War. As the region drew a growing share of both US and European direct investment, US and European policymakers, buttressed by supporters in the corporate sector, advocated a new economic internationalism in order to create a more favorable climate for private capital. The incoming Kennedy administration advanced a new approach to foreign policy in which countries should be unified into "cooperative economic units" along the lines of the recently-established European Economic Community (Gambone 2001:71). This new internationalism was pursued in force through the Alliance for Progress, enacted in 1961 at Punta del Este, Uruguay with the commitment of almost $2 billion in public and private funds to promote economic reforms and broad-based development goals in the region (Gambone 2001:71). In this way, regional economic integration was part of a shift in US foreign policy that positioned 'development' (meaning primarily the expansion of the private sector) as a primary strategy of forestalling resistance to US economic interests.

One of the most ardent proponents of the new internationalism was New York senator Jacob Javits, for whom a Latin American common market was the cornerstone of

a vision of "an all western-hemispheric free trade zone" and a crucial part of curtailing the spread of communism (Rivera 2007:24). Recognizing the need to accelerate the investment of private capital in Latin America, in 1962 Javits recruited international business leaders to create the Atlantic Community Development Group for Latin America (ADELA), a cooperative investment institution financed by corporate shareholders that would pursue the linked agendas of economic integration and the expansion of the private sector. Alongside leaders from the Inter-American Development Bank, Standard Oil, Texaco, and the First National City Bank of New York, Javits tapped Peccei to help recruit leading European businessmen, and many of Peccei's close alliances in Latin American business and government were early participants (Rivera 2007:10; Pauli 1987:52-3). ADELA's approach to private-sector-led social development resonated with Peccei's vision for the social role of the multinational firm; as Pauli (1987:54) writes, for Peccei ADELA "had demonstrated that new ways exist to revive, and even reinvent, the function and the activities of private enterprise in a changing world."

Global management on the shop floor

Throughout his international undertakings Peccei remained directly involved with the activities at Fiat Concord, both as Chairman of the Board and through his close relationship with its president, Oberdan Sallustro, who reported to Peccei on a daily basis (Pauli 1987:44). In the early 1960s Fiat Concord took advantage of the liberal economic reforms of the Frondizi government to expand into commercial automobile production (Brennan 1994:16; 38). As the company and its factories grew, "in Turin some people

claimed that Aurelio [Peccei] was turning Fiat Concord into a little private empire" (Pauli 1987:36).

These liberal policies, however, planted the seeds of the industry's demise in the midst of its heyday. Brennan (1994:38) shows how the combination of increased competition with the influx of American and European capital, the rise of a post-Perónist anti-union dictatorship, and deteriorating working conditions in Córdoban factories established the conditions for the working class mobilizations that most violently expressed the industry's undoing. Córdoban autoworkers would become the motor of Argentina's militant labor movement throughout the 1960s and 70s, a movement that was instrumental in toppling the Illia dictatorship in 1965 and the Onganía dictatorship in 1969, and whose strike actions catalyzed two urban insurrections in 1969 and 1970, respectively (Brennan 1994).

Peccei's career, therefore, directly linked the struggles taking place on the shop floors and streets of Córdoba with the international politics of development as a strategy for forestalling revolutionary movements in Latin America. Peccei's conversations with Sallustro were not limited to Fiat affairs, but also extended to the "world situation," in long evenings of reflection on "strategies for development, the impact of new technologies, the opening of the market in the Soviet Union, or the role of Europe in world affairs" (Pauli 1987:44). In his book *The Chasm Ahead*, Peccei (1969:261) repeatedly asserts that he has "looked at the world through the eyes of a manager who sees that too many grave problems remain unresolved and become more serious every year." Among the "pseudo-solutions" that he sought to prevent with his managerial approach was the "contestative, and equally negative, conclusion that only tragedy or

revolution can transform the rotten setup evolved by our (capitalist yes, but, why not, also communist) civilization" (261-2).

The rise of a militant revolutionary labor movement from within Fiat's Argentine factories provides an essential context for Peccei's writings of the period, and one that remains totally unacknowledged in histories of the Club of Rome and *The Limits to Growth*. In pamphlets, published work, lectures, and meetings with government decision makers in the US, Europe, and Latin America throughout the 1960s and 70s, Peccei articulated an impending global crisis as, above all else, a crisis of management, at the precise moment when factory occupations on his own shop floors were demonstrating management's superfluity and incompetence. Situating Peccei's work in the crisis of Fiat's control over its labor force illuminates the crucial and unacknowledged political context for the global environmental imaginary articulated in *Limits*, as well as the role of global modeling in articulating that vision.

As Brennan (1994:82; 64) writes, Fiat had imported its "traditional mix of paternalistic and authoritarian policies" from decades of experience with labor resistance in Turin where, in 1955, it had just completed a nearly 10-year labor struggle. Among European automakers, Fiat was notable for its use of paternalistic policies such as sports clubs, hospitals, and social programs designed to cultivate in workers a sense of loyalty to "la famiglia Fiat" (Brennan 1994:175; see also Pauli 1987:43). It also stood out among its American and European competitors by virtue of its hostility to unions and its emphasis on squeezing labor costs, rather than investing directly in production, as a way of contending with fluctuations in profits (Brennan 1994:323). Fiat was slower to adopt technology as a means of disciplining labor, relying more on outmoded tactics such as

piecework that tied remuneration to production levels, alongside repression of union activity on the shop floor to maintain absolute control over production rhythms (Brennan 1994). It brought these methods with it to Córdoba where it successfully isolated its workforce from the broader labor movement in that city, which was becoming increasingly militant in the late 1950s and 1960s both within and outside the automotive sector. As its chief competitor, IKA, and the city of Córdoba itself was wracked by the first of many "active strikes" (*paros activos*) that resembled popular mobilizations more than simply work stoppages, a 1959 Fiat internal memo noted approvingly the absence of labor problems in its factories in contrast to what was happening on the "outside" (quoted in Brennan 1994:64).

Fiat's efforts to isolate its workers from such 'outside' influences would define its labor strategy in the coming decade. In 1960, it worked with the labor-hostile Frondizi government to create company unions at all three of its plants, in an effort to forestall organizing efforts even by the largely business-friendly Perónist labor establishment. The cracks in this strategy began to appear as soon as 1964 when, in the context of a General Strike, Fiat's workers were targeted by multiple competing unions vying for influence in the plants, culminating in "a bitter 1965 strike in the Ferraya plants" (Brennan 1994:81). At the end of this upheaval, the company lost control of its workers at the Grandes Motores Diesel plant to a more militant union representing IKA workers. Its response was to further entrench its paternalistic approach, expanding its social programs and consolidating control over its two remaining company unions. This was especially the case at Fiat Concord, where Peccei was Chairman, and where the company union was

transformed "into an appendage of its [Fiat's] industrial relations department, to be at the bidding of the company rather than its workers" (Brennan 1994:82).

During this period Peccei was engaged not only in the politics of work at Fiat Argentina, but also in the transformation of work via information technology back in Italy. In 1964, he was asked to return to Italy to take over as managing director of Olivetti, Italy's leading manufacturer of business machines which, in 1959, had created the first transistor-based computer (Pasquinelli 2014). He agreed to the position on a part-time basis, so as to retain his positions at Fiat Concord, ADELA, and Italconsult. The same year Peccei joined, the company released the Programma 101, the world's first desktop computer, at the New York World's Fair (Brennan 2015). At Olivetti Peccei acted as a "crisis manager" directing the company's restructuring at the demands of its creditors, a primary goal of which was cutting labor costs and increasing productivity (Pauli 1987). As he stated in 1965, "[m]y task at Olivetti is to shake up the structure of the company, so that new ideas can circulate and new managers can develop their talents" (quoted in Pauli 1987:58). Between 1964 and '67, Peccei streamlined the company and expanded its reach into Latin America and the USSR, and was widely credited with its recovery by 1965.[39]

[39] See Koshetz 1965; "Olivetti Expects Sales…" 1966; "Italy: The Renaissance" 1967; and Castagnoli 2014. One of the more controversial decisions made during Peccei's tenure was the sale of Olivetti's computer division to GE, to form a new Olivetti-General Electric company in which Olivetti retained a 25% share (Pauli 1987:57; Castagnoli 2014). While this decision may seem incongruous with Peccei's enthusiasm for computing and information technology (explored below), from the perspective of the industry as a whole the decision made sense. Castagnoli (2014:1302) calls the sale a "missed opportunity" for Olivetti, but also notes that it contributed to both expanding and "Americanizing" the Italian electronics industry. This is in keeping with Peccei's broader vision for technological development. The fact that Fiat owned an interest in GE was also a contributing factor (Castagnoli 2014:1302).

In the early 1960s Olivetti was a pioneer not only in computing, but also in new labor processes that incorporated information from workers on the line in a "primitive form of digital 'feedback'" that enabled flexible control of production and efficiency (Brennan 2015:239). And it was Olivetti, alongside Fiat, that was the subject of early "co-research" endeavors through which scholar-activists in the *operaismo* movement would theorize the "new working class" (Wright 2002:46).[40] As Matteo Pasquinelli (2014) has argued, from the perspective of contemporary autonomist thought Alquati's notion of "valorizing information" (*informazione vallorizzante)* developed in those studies constituted the first effort to theorize the emergence of a cognitive mode of capitalism defined by 'immaterial labor' (see also Brennan 2015).

In this way Peccei was situated at the intersection of the globalization of manufacturing and the new technological and social forces that would come to define post-Fordist labor. He sought to navigate this transition as a manager, and to develop a style of management that would be relevant to these new forces. Like Alquati, Peccei was keenly aware of the significance of the new technological relations, and during this period he became convinced that a "new industrial revolution" was underway defined by the changing "relationship between man and machine:"

> He saw it in the Fiat factories, where production was being revolutionized by machines… Aurelio uttered the term 'artificial intelligence' again and again at the meeting of the board of Olivetti in 1964. He predicted that by 1970 telephone traffic for the transmission of data among machines would exceed voice traffic. He said that the emerging interdependence of man and machine would change humans as humans had changed the machines, would affect the socio-cultural environment relations among societies and people's views of themselves; and would change their whole philosophy of life. Education would need to be redesigned and political concepts altered. He further declared

[40] In his history of Italian *operaismo*, Steve Wright (2002:53) calls Romano Alquati's studies of the Olivetti work process in *Quaderni Rossi* (the founding journal of *operaismo*) "the most complex and sustained of the journal's analyses of class composition," in which the new relation between worker and machine first became an object of sustained inquiry.

that, if this vision of the near future proved true, then we were entering a phase of explosive change unprecedented in history… 'Are we capable of controlling our future, or will the world fall to pieces?' he asked (Pauli 1987:10).

It was during this period of labor unrest in Córdoba and restructuring at Olivetti that Peccei began to distribute a pamphlet that would become the basis for his 1969 book *The Chasm Ahead*. As Pauli (1987:8) writes, in that booklet Peccei "wrote and thought as a manager" about the "world situation," drawing on his experience working in China, Latin America, and the Soviet Union. Peccei highlighted three primary areas of concern in this early work: 1) US-European relations, and in particular the growing technology gap between them; 2) East-West dialogue and trade; and 3) Latin American development. These problems, for Peccei, were essentially interconnected: based on his experience in Latin America, he perceived underdevelopment to be the primary source of social and political unrest in the Third World, and a threat to "stable world equilibrium" (Peccei 1965/1987:106). Solving the problems of underdevelopment, for Peccei, required a collaborative partnership between the US and a united Europe, neither of which could function alone as world leader.

Chief among Peccei's concerns was the growing technological gap between the US and Europe, characterized by US advances in computers and systems analysis and their application to industrial planning, production, education, and social development in general. "While America blazes a trail," Peccei (1969:62) complained, "Europe meanders." For Peccei, no other technology promised to transform human societies to such a great extent as computers (Peccei 1969:15). On one side of the "chasm" marked by the Atlantic, America had entered the "IBM age" while Europe remained in the "GM

age," where "the civilization of the internal combustion engine and the manufacturing plant still reigns with all of its predominant features" (64).

In an era dominated by increasingly global corporations with the financial and institutional capacity to automate production, Peccei observed that European companies were being quickly outpaced by American ones in terms of productivity, size, and market share, even in European markets (Peccei 1969:27, 42). The chasm was also "a managerial gap," defined by a discrepancy in the capacity for managing large and complex firms (27).[41] Peccei therefore advocated for an Atlantic partnership based on a "continuous flow of technology, management skills and industrial know-how" that would operate as a driving force of global development, beginning with the Latin American region (Pauli 1987:12). For Peccei, Latin American industrialization provided the essential frontier for a new era of development in which the increasingly-global operations of multinational corporations would be a driving force. As Pauli (1987:13) writes, for Peccei "Latin America was a testing ground, where the effort to extend prosperity to an entire continent would prove either feasible and practical, or impossible."[42]

In the second half of the 1960s, Peccei advocated for these ideas through lectures at US universities, testimonies before the US House Foreign Relations Committee, and a

[41] Peccei (1969:47) wrote: "[T]hanks to computer-based experimentation and technology, the application of scientific methods is being made possible to improve the organization and decision-making processes in complex systems of men and machines, in which highly trained personnel interact in a dynamic loop with extremely sophisticated equipment… American management has been quick to understand these new opportunities, whereas in Europe rigidity, centralization and a cult of tradition prevail."

[42] In a 1965 speech, Peccei stated: "I believe it is not difficult to explain the reasons which militate in favor of the absolute priority to be given in this setting to Latin America rather than to other developing regions. As far as I am concerned, for many years I have made a modest but indefatigable contribution to the clarification of the singular place held by Latin America in the future of the West, to the study and development of its resources, to the preparation of a coordinated policy between the United States and Europe on that continent. Today I am convinced that, if the area of well-being cannot be extended to Latin America in the near future, it will never be possible in other underdeveloped regions." (Peccei 1965/1987:122).

1965 speech delivered at a meeting organized by ADELA of Latin American bankers and businessmen at the Buenos Aires military academy, entitled "The Challenge of the 1970s for the World of Today" (King, 2005a:52; Peccei 1965/1987). Peccei sent copies of the speech to the US State Department[43] and circulated them at UN meetings. In a personal memo, John Rielly, assistant to Vice President Hubert Humphrey, called Peccei's speech "the most helpful of all the analysis we examined" on the problem of the technology gap between the US and Europe, and noted its influence on the President's and Vice President's recent speeches on the subject (Rielly 1966). In meetings with Humphrey in 1965 and 1966, Peccei sought US support for Aldo Moro's center-left government in Italy in order to strengthen the position of Italian business, and was consulted on Latin American integration. As Rielly described in a memo to Humphrey, "Peccei is very much interested in having Italy play a larger role in the developing world, particularly in Latin America. Moro is also very much interested in this, particularly in certain countries in Latin America and would like to talk to you about it" (Rielly 1965).

For Peccei, the problem of underdevelopment was also an opportunity for advancing the role of European multinationals in the global economy, and for increasing European competitiveness vis a vis American manufacturing. Peccei's concerns about the technology gap were directly linked to Fiat's position in the Argentinian auto sector. Through Peccei's close coordination with successive governments, Fiat had benefited from the protectionist policies of Argentinian leaders that had largely insulated it from open competition with major US companies in the region. The increasing liberalization of the Argentine economy in the 1960s expanded Fiat's opportunities for direct investment

[43] Apparently the speech impressed Secretary of State Dean Atchison, who King notes "is said to have remarked that it was much more successful for not having been presented by a Yanki" (King 2005a:52).

and the repatriation of profits, but also increased its competition, particularly from General Motors and Ford in Buenos Aires (Brennan 1994:310).

But while Peccei glorified American advances in the application of computers to manufacturing and industrial organization, in particular automation at GM (Peccei 1965/1987:115), Fiat's response to these competitive pressures would look quite different. When a military coup in 1966 installed General Juan Carlos Onganía as president of Argentina, he immediately undertook reforms to increase foreign investment, break union power, and reduce public spending (Brennan 1994:104). Emboldened by its continued growth and Ongania's anti-labor agenda, Fiat sought to reduce its costs not by investing in technology to rationalize production (as would their competitor IKA), but rather by amplifying its established tactics for squeezing worker productivity.[44]

While the automotive industry in general is characterized by the volatility of its business cycle, this was especially the case in Argentina (Brennan 1994:313). Due to the nature of the Argentine labor market, the seasonal hire-and-fire strategies favored by US auto manufacturers were unworkable in Argentina, as were wage cuts. Instead, Fiat used various tactics to link wages to productivity and to speed up production, such as the *acople de máquina* ("machine yoke") that tied a worker to multiple machines at once, resulting in extreme exhaustion (322). In all of these practices – many of which were illegal in Italy – Fiat took advantage of a state hostile to labor in order to maximize productivity through rigid factory discipline (324).

[44] Brennan argues that, given the country's more limited capital and consumer markets, getting control of labor costs was even more important in Argentina than in Europe or the US. "In the course of the 1960s," he writes, "inefficiency and inflated labor costs, real or imaged, became the source of company grumbling at both IKA-Renault and Fiat" (1994:313).

As labor relations in the Córdoban auto industry were growing worse, Fiat's control over its workers through its company unions grew increasingly tenuous. Onganía's cuts to public spending and his efforts to break the power of labor in national politics were met with bitter resistance in Córdoba. Beginning with a 1967 general strike, protests erupted at virtually all of the major automakers throughout 1967 and 1968, save Fiat (Brennan 1994:110). Meanwhile, the Córdoban automotive workers were also becoming more integrated with the revolutionary left and the student movement, with whom they shared resources, facilities, and solidarity strikes (127). Córdoba was "Argentina's 'red city'" in the late 1960s, the epicenter of the new left's break with the Communist and Socialist Party establishment and the heart of a growing liberation theology movement (128).

Just as Peccei was laying out his paternalistic management vision on a global scale in his 1969 book, the volatile movements surrounding Fiat's factories were threatening the continued efficacy of this strategy in Argentina. In 1969, Córdoba exploded with the first of two urban insurrections that would define the new revolutionary alliance between labor and the New Left. Termed the Cordobazo, the uprising of May 29th-30th 1969 represented a seminal moment in 20th century Argentine politics, discrediting the authoritarian Onganía regime and unleashing the forces that would lead to its downfall within the year. As Brennan (1994:169) writes,

> One of the most significant changes took place in Ferraya, where years of union collusion with the Fiat company and an ignominious passivity during the Cordobazo had left the workers particularly susceptible to the influences that the May uprising had unleashed. This susceptibility coincided, moreover, with renewed efforts by the Italian company to reduce its labor costs and increase its competitiveness, encouraged by the progress it had made in recent years in the automotive market.

The Cordobazo catalyzed the frustrations of the isolated Fiat workforce with its ineffective company unions, which erupted in a series of factory occupations in 1970 and 1971. It was a turning point in Córdoban politics that brought the revolutionary left deeper into the auto factories (Brennan 1994:171). This alliance gave rise to a new revolutionary force in Argentinian politics, the *clasista* movement, which positioned itself against the conciliatory and 'verticalist' bureaucracy of the Perónist labor establishment. In close communication with Fiat's unions in Turin, *clasista* unions learned that many of Fiat's labor practices in Argentina had long been illegal in Italy (Brennan 1994:322, note 47). Through factory occupations, work stoppages, hunger strikes, and mass protests, *clasistas* wrenched control of the company unions from Fiat and became the epicenter of working class politics in the city. As Brennan (187) writes, in 1970 "Fiat was now a company under siege, and it was paying for the failure of its previous labor policies and past duplicities in dealing with workers."

These labor mobilizations represented the volatile undercurrent of multinational production – namely, that it extended the labor-management antagonism across global space. Fiat was faced with a labor war on two fronts, characterized by an explosive mobilization of its Turin workforce in 1969 and the parallel disruptions in its Córdoban factories a year later (Brennan 1994:324). Just as its Turin plant would become the center of the alliance between New Left radicals and workers that would give rise to the *autonomia* movement in the latter part of the 1970s,[45] Fiat's Córdoban factories were the primary focus of a number of Marxist, Maoist, Guevarist, and other revolutionary parties vying for influence in the plants. As Brennan (1994:182) writes, the Fiat union hall

[45] For Anglophone sources on the *autonomia* movement, see Lotringer and Marazzi 2007a and Virno and Hardt 1996.

"became a kind of political salon for the Córdoban left, a meeting place where they could analyze the daily reality workers were confronting in the plants and give it political explanation and, eventually, an ideological expression."

But whereas management would characterize the movement as a kind of "industrial terrorism" instigated by outside forces, Brennan stresses that it was the concrete problems of work in Fiat factories that gave rise to the militancy of the *clasistas*, stemming directly from Fiat's particular combination of "ostentatious paternalism" with authoritarian control on the shop floor (Brennan 1994:335, 324). A second urban insurrection in 1970 further integrated *clasista* ideas into shop floor struggles, and demonstrated the centrality of Córdoban autoworkers to any future revolutionary project (Brennan 1994:196). Faced with these uprisings Fiat only retrenched its repressive strategies, once again relying on a labor-hostile government to wage a "terror campaign" against workers and to avoid a compromise (197).

In March 1972, the danger of the emerging alliance between workers and the revolutionary left was demonstrated to Peccei in personal terms when Sallustro was kidnapped by the People's Revolutionary Army (PRA), the military wing of one of the most active *clasista* parties organizing in the Fiat plants. While the kidnapping was an independent action of the PRA, Fiat immediately attempted to implicate union leadership in the action, buttressing management's already unyielding stance toward negotiations (Brennan 1994:202). When local police botched Peccei's attempt to negotiate Sallustro's release, resulting in the latter's murder, Peccei portrayed the loss as emblematic of the broader global situation:

The lesson of Sallustro's death and its deeper meaning are that we are all guilty. This is only one event, in one movement, which is part of a profound revolution occurring in all our countries. We must succeed in creating a more just society, or this experience will be repeated again and again. Modern society is so complex and so delicately balanced that is can be upset and paralyzed even by unhealthy and irrational forces. Until our so-called 'technical society' becomes human as well, violence will continue to triumph and we will continue to misunderstand and resist, little realizing that it is the injustices in our societies that we should be fighting. (quoted in Pauli 1987:46)

Peccei retired as Fiat Chairman in 1974, shifting his focus to his work with the Club of Rome. As Pauli (1987:13) writes, Peccei's thinking on global problems would evolve over the next decade: "The Atlantic Partnership soon became less important in his analysis; and the role of Latin America as a testing ground for development no longer seemed so clear, perhaps because of his experience with the ultimate lack of success of Fiat there." Ultimately, Peccei's "private empire" (Pauli 1987:36) in Argentina would itself be a casualty of Fiat's two-front labor war. In his account of Fiat's assault against the uprisings in its Turin factories in the late 1970s, Fabrizio Galimberti, Fiat's chief economist in the 1980s, explained that Fiat's restructuring was accomplished through the combined strategies of automation and the reduction of its global reach: "In Latin America, FIAT's activities in Uruguay, Chile, Colombia and Argentina were sold out or closed," and its more recent operations in Brazil (where state oppression of labor was more successful) remained its only major production affiliate overseas (Galimberti 1986:29; see Brennan 1994 on Brazil).[46]

If the decline of Fiat Concord was an indication of the failure to achieve a new Keynesian compromise in an economic level, its failure on a political level was presaged

[46] The decline of Fiat in Argentina was not only due to the company's escalating labor war, but also to the early neoliberal reforms of Argentinian governments, who — in an effort to decisively break the power of labor and unravel the last remnants of protectionism — opened the country to automobile imports. As Brennan (1994:326) writes, "By the early 1980s, Chrysler, GM, Citroen, and Peugeot had all abandoned their plants in Argentina."

by the Sallustro affair. Just five years after Sallustro's death, that event would be mirrored by the kidnaping of Aldo Moro, the former Italian Prime Minister and leader of the Christian Democrats strongly supported by Peccei. At the time of his kidnapping, Moro was about to begin negotiations designed to instigate a new "historic compromise" in the form of a Christian Democratic-Socialist Party cabinet supported by the Communist Party, in the midst of a deepening social crisis and violent state crackdown on dissidents (Drake 2001). When Moro was assassinated 55 days later, the event was exploited to justify stronger suppression of Left radicals, including Antonio Negri and other leading figures in the autonomist movement who were framed and jailed for the murder (Lotringer and Marazzi 2007b:9). If Sallustro's death demonstrated the global crisis in "personal terms" for Peccei, the Moro murder can be seen as confirming the failure of the social democratic political solution to the crisis, and the impossibility of instituting a new Keynesian compromise that would contain the social forces erupting from New Left movements and the reactionary forces seeking to eradicate them.[47]

Ironically for Peccei, the revolution in production promised by automation and new technologies would not come from a pro-active and globally-oriented management philosophy of Fiat leadership but from the violent confrontation with its Turin labor force. In Turin, "Wildcat strikes, absenteeism, and, in some cases, outright indiscipline and even sabotage threatened the very fabric of factory life," coinciding with the 1973 energy crisis and companies' concerns over the limitations presented by an "energy-

[47] There are many conspiracy theories that members of the Italian political establishment hostile to the compromise were instrumental in his murder (Drake 2001), and there is some evidence of US involvement, since Moro's proposed compromised was directly opposed to US Cold War objectives (Moore 2008). Thus the 'failure' of the compromise should not be taken as a given, but the result of a convergence of forces including the deliberate efforts of reactionary interests to undermine it.

warranted growth path" (Galimberti 1986:25) — a growth path of which *The Limits to Growth* report was one of the primary influences. In 1980, the company finally rid itself of its belligerent workforce by firing some 23,000 workers, or about 15% of its total workforce. As Galimberti himself wrote, "The opposition [that is, the unions] rightly perceived that if restructuring on such a scale was allowed, it would mark a watershed in the balance of power, it would set a tone for a new era of industrial relations… Layoffs were not linked to the weakness of the market, to a movement along the cost curve, but to a shift in the cost curve towards a different production function" (Galimberti 1986:26).

The Club of Rome: Managing global futures

The future should be viewed as the solution to the present, not as an extension of it.

– Hasan Ozbekhan[48]

The years of heightened labor unrest in Córdoba were the formative moment for Peccei's conception of global problems. It was during that time that Peccei engaged in the international conversations that would lead to the formation of the Club of Rome, and that he developed his ideas about global management that would inform his goals for that group. A copy of Peccei's 1965 speech, which he had circulated at UN meetings, had been picked up by the Soviet delegate Jermen Gvishiani, who in turn connected Peccei to Carroll Wilson at MIT and Alexander King, Director General of Science, Technology and Education at the OECD (King 2005a:52; Pauli 1987:72). Like Peccei, Gvishiani and King were concerned with emerging "global dangers" including overpopulation, environmental degradation, poverty, and technology, and were dissatisfied with the abilities of the international community to contend with these problems (King 2005a:53).

[48] quoted in Peccei 1969:229

In an attempt to formulate a global approach to these problems, King asked his consultant, the systems scientist Erich Jantsch, to draft a keynote paper for discussion at a meeting among "a few eminent Europeans of broad outlook" (King 2005a:53). Held at the Academia de Lincei[49] in Rome in April 1968, the meeting was sponsored by the Agnelli family of Fiat. In King's words, it was "a monumental flop" (King 1979/2005b:34). In addition to the difficulties presented by Jantsch's highly-academic paper, entitled "A Tentative Framework for Initiating Systems-Wide Planning on a World Scale," discussions foundered on semantics, the practicability of planning on a global scale, and the type of organization that should undertake such planning (King 2005a:53; Elichirigoity 1999:64). While Peccei and King held up the US Rand Corporation as a "model of successful forward planning," others felt that such an organization was not consistent with European society and culture. When one participant suggested that "it was unthinkable to have the Vienna Opera House and a Rand Corporation on the same continent," King "angrily rejoined that it was impossible to envisage a future Europe that did not have both" (King 2005a:53).

Upon the conclusion of the meeting, a disappointed Peccei invited King and four other participants to dinner at his apartment. This core group decided to continue the discussions, naming themselves the Club of Rome in honor of the location of their first meeting (King 1979/2005b:34). The group considered themselves a "non-organization,"

[49] The Academia die Lincei is the oldest academy of sciences still in operation, having been a key locus of Renaissance thought and culture; among its former members is Galileo. Peccei and the other early members of the Club understood the Club of Rome to inherit the lineage of such influential organizations operating in the background of major social and cultural transformations (Peccei 1969:251). Similarly, King understands the Club of Rome to operate in the legacy of the Lunar Society of Britain, a group of scientists, industrialists, and intellectuals who King suggests "triggered off the industrial revolution" (King 1979/2005b:35; see also Pauli 1987:71-2). Among contemporary examples of such organizations they held the Rand Corporation in particularly high regard (e.g. King 2005a:53; Peccei 1969:53).

"practically structureless," with a maximum membership of 100 and Peccei as unofficial President (King 1979/2005b:33). King insisted that the Club had no "political ideology," and its members deliberately excluded those holding political office. Nevertheless, the Club was expressly political in that its primary intention was to influence policy, and Peccei, King, and other members traveled extensively in North America, Europe, Japan, the Soviet Union, and the Third World to advocate for "a new approach to the world predicament" (King 1979/2005b:34).

The Chasm Ahead

Peccei's concept of global crisis and his vision for the Club of Rome can be gleaned from his 1969 book *The Chasm Ahead*, which was intended to convince an American audience of the need for Atlantic cooperation in guiding global development in the 1970s. In that text, Peccei described a world riven by three great "fissures:" first, the technological between the US and Europe; second, the growing tension between the USSR and China over the former's inability to sufficiently finance Chinese development; and third, a split within the Third World, where (as he had written earlier) "The spirit of Bandung has had its day, now that the anti-colonialist coagulant has faded" (Peccei 1965/1987:110). Thus a division was widening between a rising Latin America that had "entered its candidature… for a higher place in the world" and a stagnating Asia (excluding China and Japan) and Africa (110).

In this context, Peccei described an impending crisis precipitated by both internal and external forces of disruption to the 'system' of Western civilization:

> As a matter of fact, the drastic change in the direction of our march, the reordering of our priorities to something that is more real and more vital, and the redefinition of our

objectives, to make them constructive in this age of extreme alternatives, are made necessary not only because the outer world, the outer continents, and the natural cycles, are becoming intimately connected with the continent system in which Americans and Europeans live, and influence all its functions every day and every year. It is not only that we can no longer walk out of other peoples' history, but that our own world has changed. The sharp realization that grows ever more dramatic is that *a crisis has entered our society*, and is unequivocally confronting the best part of it — our youngsters (Peccei 1969:271).

On the one hand, the crisis Peccei described was precipitated by a volatile exterior – including the "outer continents" as much as the natural environment – that imposed itself on Western civilization to the extent that the latter was no longer insulated from its constitutive outside, namely the formerly-colonized world. At the same time, it was also emergent from the internal complexities of the advanced societies themselves. Peccei therefore drew a direct link between problems in the global economy, international politics, environmental issues, and new social movements, the student movement and its effects on "our youngsters" being for him a primary symptom of this generalized crisis of Western civilization.

In this text, Peccei took up the ideas of systems analysts and linked them with his own management philosophy and experience to describe the global situation as, above all else, a crisis of management. For Peccei, systems thinking was not a naturalization of self-regulating market forces, but a framework for understanding the breakdown of market equilibrium. Given the positive feedbacks among contemporary global problems, we could no longer rely on "the myth of the 'invisible hand' that in nature and the economy comes to the rescue and promptly reestablishes equilibrium when it has been upset" (Peccei 1969:246). In this context, he positioned management as an operation of maintaining stable equilibrium in systems that would otherwise lack the capacity for self-regulation. "[N]ow that he has created forces and cycles which compete and interfere

with those of nature itself, but which have no in-built regulating mechanism, *man – to avoid economic, social, political, demographic or ecological debacle, and guide his destiny – has himself to be the cybernetic regulating element of all man-influenced processes*" (136, original emphasis; also 216).

Peccei's concept of a global macrosystem whose stability was under constant threat of disruption from instabilities in its "subsystems" reflected his experience of the automotive production process. As Brennan (1994:312) writes,

> The automotive plants' web of parts- and materials-producing departments, each engaged in its own production processes, created a clockwork-like operation whose enormous manufacturing capacities were ironically offset by their vulnerability, work stoppages in any one department being capable of paralyzing the entire line of production.

Peccei perceived the same dynamic of complexity and vulnerability in the global macrosystem that was demonstrated by the "quickie strikes" and work stoppages in the Córdoban plants. The very interconnectedness of the modern world system generated feedback effects that amplified "uncontrolled and convulsive situations" across multiple domains, such that ecological, social, political, and economic problems could no longer be confined to separate spheres of understanding or governance (Peccei 1969:2). "To match the complexity and dynamism of this plurality of interlocking systems, and prevent disaster," he argued, "new planning of worldwide scope is urgently needed" (Peccei 1969:242).

In the world system, the disruptive forces threatening global stability stemmed above all from underdevelopment in the Third World. Mirroring Fiat's own paternalistic approach, Peccei stressed the importance of Atlantic leadership for "needy nations," lest the latter "drift toward chaos and anarchy, thus further disrupting the entire international system" (Peccei 1969:101). His strategy for the Great Change of Direction to be

undertaken in the 1970s entailed first and foremost Atlantic unity, followed by East-West cooperation, which would enable the Great Four of the US, Europe, USSR, and Japan to assume "a superrole in organizing the future world" (275). Here again, Latin America – in particular Argentina, Brazil, Mexico, and Venezuela – was in a special category with regard to the rest of the Third World, serving as a "test case" for the possibilities of development (191). With a longer history of independence and an established political and capitalist class, the region could be "a source of excellent human material" for guiding other developing countries (280). Latin American development should thus be made a priority among Atlantic nations through, among other things, trade assistance and financing, commodity and price stabilization, and the establishment of a regional free trade area (185). For its part, the rest of the world – primarily Asia and Africa – would have to wait until at least the 1980s to be brought into the "platform of common prosperity" (191).

Futurological research played a central role in Peccei's vision of this new world order. The Great Change of Direction would begin with "Project 1969," which Peccei described as a "multinationally sponsored feasibility study on systematic, long-term planning of world scope," combining the state of the art in forecasting, prospective studies, systems analysis, and computer modeling (219). The 1968 meeting was a first step in this direction (252-4). Project 1969 would be guided not by governments, but by an autonomous "World Forum" governed by an International Board of "nonpolitical American, European, Soviet, and Japanese scholars, executives, and moral leaders" appointed by the sponsoring nations (254). The headquarters of such a Forum would naturally be in Europe (261). Peccei was adamant that this World Forum not become an

international organization such as the UN, which was "too 'politicized'" and whose "large membership and voting rules make it the antithesis of efficiency" (263).

For Peccei, the true vanguard of the emerging global society was not international governance institutions, but multinational corporations. "[T]he modern corporation," he wrote, "…has been quick to see that this one-world perspective offers an ideal framework and unprecedented opportunities to maximize profits earned and services rendered" (Peccei 1969:151). Multinationals were the leading example of the new global institution and the primary agent of its establishment in other areas. Through its international operations and its strategies of global planning, the emerging "world company" would and "partially shift the government-industry interface to a supranational level" (153). In the new international order, the multinational corporation would undertake large-scale projects in social development including urban affairs, agriculture, and education, serving as a general "planner for society" (153). Above all, it would bring to the new macro-problems the ability to develop and execute long-term strategy through "experienced, hard-nosed management" (153).

The transnationalism of the world company would differ from an internationalism of nation-states, constrained as these were by "old-fashioned" concepts of territory (Peccei 1969:147; 152). To free the multinational corporation from this institutional "relic of the past" (265), Peccei suggested creating an "international zone of convenience" for their incorporation, analogous to flags of convenience for ships (152). "I believe that in practice there will be a progressive deflating of national sovereignty," Peccei wrote, a "'desovereignization' of the state, similar to the proposed demonetization of that other myth, gold – parallel to the formation of other spheres of power of varying multi-national

or regional composition… which will seek and find a mutual balance imposed by the logic of technology and planning" (148). With prescient foresight, he predicted that the study of strategies for breaking through the "fortress of the national state" was "likely to occupy the greater part of the seventies" (262).

Until the time when a "frontal attack" on the nation-state system was possible, however, Peccei advised a soft approach based on promoting "new elites" who could lay the ideological groundwork necessary to spawn new international institutions (Peccei 1969:262). It was here that computers and systems science played a key role:

> Nowadays, all peoples are awed and fascinated by the new technologies they do not understand, far less dominate. In my opinion, therefore, they are prepared, for quite a number of years, and on condition, to recognize and respect a new world Moderator, even a new Authority, set up by those who master the esoteric technologies, the Great Four, even if it is a far away, supranational, non personalized, and vicarious authority. (277-78)

The application of new technologies of systems analysis and computer modeling for global problems served, for Peccei, both an instrumental function in forecasting and planning global futures, and an ideological role in convincing the masses to participate in these futures. "There must be something wrong in the core of our society," he wrote, when its youth "rebel in their seats of learning against certain aspects of the society they are about to enter" (271). One of the main functions of Project 1969 would be to redirect the misplaced energy of the youth back into productive channels; he hoped it "may give people, particularly the young, a stimulus to bend their energies to the solution of existing problems, not to the creation of new ones" (272-3).

For Peccei, the breakdown of global equilibrium was not only a failure of the "invisible hand" of the market, but also a failure of democracy. A pervasive fear of democracy and politics is evident throughout *The Chasm Ahead*, undoubtably shaped by

Peccei's experience in Argentina.[50] The mandate for the "new world Moderator" would come instead from a "new *Social Contract*" premised on the promise of development and a commitment to need-based foreign aid (Peccei 1969:279, original emphasis). Peccei was clear that the urgency of global crisis demanded "stern rules about voting," in which "the Great Four are clearly in a different category from the other nations and peoples" (279). In this paternalistic approach, development along lines favorable to the most powerful countries was both an end goal and a means of appeasing the otherwise volatile masses to the point where they could be rendered manageable. Quoting Robert McNamara, Peccei concluded, "Security is development" (188).

For Peccei, therefore, the effort to apply systems modeling to world problems was a key step toward this new era of world planning, coordinated and executed by a technocratic World Forum that would supersede the inefficient structures of international consensus. Peccei envisioned a new international order in which the multinational corporation would be a driving force of globalization and in which the nation state would recede in importance, but one that departed significantly from a neoliberal imaginary, proposing instead a capitalist planned economy coordinated by a global management authority. Development, along a trajectory determined by the planning authority of the Great Four, served the same function in Peccei's global vision as Fiat's social programs, sports clubs, and company hospitals served in his factories — namely, it was a paternalistic attempt to forestall revolutionary movements in the Third World by subsuming them into the "zone of prosperity" prepared by the coordinated authority of the First and Second Worlds.

[50] As Pauli writes, Peccei found his business planning increasingly frustrated by the "endless succession of heads of state" (Pauli 1987:39)

Global limits and world futures

In the course of his visits with government officials and decision-makers around the world, Peccei perceived that his proposals for a global approach to global problems were not being taken seriously enough.[51] In 1969, the Club of Rome decided to initiate its own global modeling project in order to catalyze further support from world leaders. They reached out to Hasan Ozbekhan, the director of planning at the System Development Corporation in California (King 1979/2005b:34), who drafted a proposal for a world model in which he described the overdetermined nature of what he called the 'world problematique':

> When we consider the truly critical issues of our time such as environmental deterioration, poverty, endemic ill-health, urban blight, criminality, etc., we find it virtually impossible to view them as problems that exist in isolation - or, as problems capable of being solved in their own terms… it is this generalized meta-problem (or meta-system of problems) which we have called and shall continue to call the 'problematique' that inheres in our situation." (Ozbekhan, quoted in Elichirigoity 1999:77)

In Ozbekhan's formulation, the problematique was not strictly an environmental problem, (though it had an environmental dimension); it was however an *ecological* problem, in a specific sense:

> Hence if we extend, as is increasingly being done nowadays, the definition of ecology to comprise all the dimensions of occurrence in our world-wide environments it becomes possible to say that we are confronted with a problematique which is ecosystemic in

[51] Reflecting on his efforts to gain support for his ideas in the US and Europe, Peccei (1969:248-250) wrote: "Taking some time off from my other occupations, I started expounding and testing these ideas in the beginning of 1966… At that time, I saw no way of a first move being made in the right direction other than by the impulse of a very strong hand in the United States, possibly at the top of the Administration, taking the initiative of having this study program sponsored and carried out by one of the large foundations, which in turn could co-opt similar bodies in other countries. Although I took great pains to make it clear that this roughly sketched and venturesome proposal was a suggestion merely to initiate preliminary studies toward what I called *universal planning*, my pleas went largely unheeded."

character. The normative statement that describes the value-content of any ecosystem is 'ecological balance.' Consequently it is the idea of *ecological balance* that can, and will, be taken as the underlying value-base of the study; for in terms dictated by our situation the 'good' is self-evidently and most generally capable of being defined as the re-establishment of that many-dimensional dynamic balance that seems to have been lost in the modern world. (Ozbekhan, quoted in Elichirigoity 1999:79; original empahsis)

Ecology here stands for the dynamic totality of relations that make up modern society, and for a normative equilibrium condition to be re-established in those relations. But what Ozbekhan's proposal promised in intricacy, it lacked in feasibility. With a proposed budget of $900,000 dollars, a timeframe of 15 months, and an open-ended process with an undefined outcome, the project did not satisfy the desires of Club members – especially Peccei – for a rapid and hard-hitting product that would spur global interest in the problematique (Elichirigoity 1999:80). When the project was denied funding from the Volkswagen Foundation, Jay Forrester, a participant in the OECD planning conference organized by Peccei and King in 1968, convinced Club members that his Industrial Dynamics methodology could be adapted to the world scale. Trained at MIT's Servomechanisms Laboratory under the cyberneticist Gordon Brown, Forrester was a pioneer in early computing and Operations Research, and was director of computer development for the SAGE air defense system (Elichirigoity 1999:49; Edwards 2000:229).[52] In the 1950s, Forrester was one of the first to apply systems analysis to the field of industrial management, when he joined the faculty at MIT's new Sloan School of Management. There, Forrester developed an experimental model of a corporation that would enable decision-makers to test the impact of management decisions on firm operations in real time. Based on his first study of General Electric, Forrester emphasized

[52] As an engineer at MIT on the project to develop the first digital computer, Forrester invented the notion of coincident-current random-access computer memory (RAM) that would revolutionize computing (Elichirigoity 1999:45).

that the information feedbacks among production, inventory, and employment led to inherent instabilities within the industrial firm, even given constant consumer demand (Elichirigoity 1999:52). These inherent instabilities, rather than macroeconomic effects, Forrester argued, led to the cyclical "boom-bust" or "overshoot-and-collapse" dynamics demonstrated in the real economy and in his models, dynamics which were exacerbated by misguided management interventions (Edwards 2000:236). Forrester (like other systems thinkers) held that, in principle, these dynamics were consistent with those in any complex system – whether biological, social, or technological (Edwards 2000:237).

The decision to go with Forrester's model was made solely by the Club's Executive Committee, under Peccei's strong leadership (Moll 1991:94; Moll 1993:803). Peccei's anxieties about systemic collapse, which in *The Chasm Ahead* moved seamlessly from global revolution and ecological disaster, were given powerful scientific support in Forrester's overshoot-and-collapse dynamics: Club of Rome member Eduard Pestel recalled that Peccei was visibly impressed "by the fact that all computer runs exhibited… a collapse mode regardless of any 'technological fixes' employed… Peccei obviously saw his fears confirmed" (quoted in Edwards 2000:243). Published in his book *World Dynamics*, Forrester's method would become the basis for the Club of Rome's project led by Dennis Meadows at MIT. Instead of the multi-dimensional and interlinked problems identified by Ozbekhan, World3 – the third iteration of Forrester's model, which was the basis for *The Limits to Growth* – contained five sectors: population growth, industrialization, environmental deterioration/pollution, food, and resources (Elichirigoity 1999:95). Environmental limits were not a discovery of *The Limits to Growth* but its presupposition, influenced by the work of ecological economists such as Kenneth

Boulding and neo-Malthusians like Paul Ehrlich.[53] Given estimated limits to non-renewable resources, the model's outcomes were largely contained in its original proposal, which stated that "Growth cannot continue indefinitely on a finite planet" (quoted in Elichirigoity 1999:96).

Aggregating the world into a single system, World3 made no regional distinctions in trajectories for resource consumption or population growth, but modeled the dynamic feedbacks among its five sectors along a trajectory of "overshoot and collapse" (Meadows et al. 1972:125). Accelerating industrialization brought a decline in death rates, which exacerbated population growth. As industrial growth maxed out energy reserves, the death rate finally caught up with population growth due to lack of food and health services, with global catastrophe striking sometime before 2100. In a second run that doubled the estimated reserves, the catastrophe was now "caused by an overloading of the natural absorptive capacity of the environment" (ibid:126). Citing the work of ecological economists such as Herman Daly and Kenneth Boulding, the authors cautioned that a future equilibrium condition was inevitable: the only question was whether it would be an equilibrium of death and destruction, or a planned equilibrium of the "steady-state society," characterized by enforced global limits on resource extraction and population growth (Meadows et al. 1972:171).

While the report's publicity campaign was an unparalleled success, it garnered widespread criticism from the academic community, and even from within the Club of Rome. Critics charged that it was blind to history, making no allowance for technological developments that would make available new resources or help to mitigate pollution.

[53] Peccei refers to the notion of "spaceship earth" repeatedly in The Chasm Ahead, and argues in a later book (1980:33) that "Paul Ehrlich… is right when he says that *a human bomb is threatening the planet*."

Resource scientists pointed out that its empirical data on reserves were seriously incomplete and outdated, rendering its quantitative estimates of limits largely arbitrary. Systems scientists questioned the model's extreme sensitivity to minor changes in its parameters.[54] But granting the validity of these critiques, *The Limits to Growth* was never intended primarily as a scientific endeavor, but as an ideological one.[55] In its Commentary, the Executive Committee claimed that "The project was not intended as a piece of futurology," in the sense that its results were not meant to be predictions of the future. Instead, they argued, it was essentially extrapolative, analyzing current trends in order to "provide warnings of potential world crisis if these trends are allowed to continue, and thus make changes in our political, economic, and social systems to ensure that these crises do not take place" (Executive Committee 1972/2005a:17). Nevertheless, if we consider futurology to be a science that mobilizes the future in order to govern the present, the report was precisely a futurological endeavor. For the Executive Committee of the Club of Rome, the model of catastrophic encounter with absolute limits to growth promised to catalyze the type of global management demanded by the problematique. Peccei in particular was committed to this ideological function of the project; despite early criticism of the model within the Club (resulting in the resignation of some members [Moll 1993]), the project moved forward based on the ten-month timeline for its release that Peccei had established in the course of his publicity campaign (Moll 1991:96). As the Executive Committee stated in their Commentary to the report, "We are convinced that realization of the quantitative restraints of the world

[54] For a diverse collection of critiques, see Cole et al. 1973.
[55] The Executive Committee of the Club of Rome (1973/2005b:23) wrote that "despite criticisms of its scientific accuracy and even its basic validity, [The Limits to Growth] confirms the qualitative and intuitive conclusions of many."

environment and of the tragic consequences of an overshoot is essential to the initiation of new forms of thinking that will lead to a fundamental revision of human behavior and, by implication, of the entire fabric of present-day society" (Executive Committee 1972/2005a:17).

With this catastrophist perspective, the complexity of the world problematique was reduced, in the report, to the simple Malthusian equation that exponential demographic growth and limitless resource consumption could not be sustained on a finite planet. The transformation of the problematique into an environmental problem therefore came as a dramatic reduction of its previous multidimensionality. But while the complexity of the problematique was diminished, its essential political point was honed: if not guided by a concerted planning effort on the part of developed countries, Third World nations threatened to become an increasingly volatile force (now chiefly framed in terms of demographic pressures) that might further destabilize global equilibrium. The Club of Rome's invocation of environmental limits therefore gained political meaning in the context of an ongoing struggle over the implications of Third World sovereignty for control of natural resources and the changing geography of production and trade.

The timing of the report was not coincidental: published on the eve of two international summits – the United Nations Conference on Trade and Development in Santiago de Chile, and the United Nations Conference on the Human Environment in Stockholm – the report aimed to provide world leaders with a framing of the environmental problem that would spur them toward global action. In keeping with Peccei's paternalistic vision of global leadership, the Executive Committee of the Club of Rome framed the project as part of its broader effort to "encourage the creation of a

world forum where statesmen, policymakers, and scientists can discuss the dangers and hopes for the future global system without the constraints of formal intergovernmental negotiation" (Executive Committee 1972/2005a:21).

But the geopolitical context in which the report landed was very different than that which Peccei had envisioned in his initial calls for the World Forum in *The Chasm Ahead*. In that text, he had lamented that the "weaker nations" could not meaningfully participate in the World Forum and its comprehensive world planning activities, "hopelessly incapacitated as they are even to meet their own present, let alone the future" (Peccei 1969:265). But in the early 1970s, Peccei's vision of a globalism driven by the multinational corporation was confronted by another global reality emerging from Third World states themselves. Beginning with the 1955 Bandung Conference that gave rise to the Nonaligned Movement, collaboration among Third World states indicated an emerging multilateral world order. This would be most strongly articulated in the calls for a New International Economic Order (NIEO), in which Third World states set out a series of demands for a new system of international relations involving an end to exploitative terms of trade that perpetuated relations of dependency, and an overall autonomy from US influence. Formally articulated at the 1973 Algiers conference of Non-Aligned Countries, the demands for a NIEO were given strength by OPEC's oil price hike of that year in response to US intervention in the Yom Kippur war. The OPEC action demonstrated the first successful alliance of Third World nations to assert control over the terms of trade for their export commodities and to use this as a political tool in international negotiations (Hudson 1977:3). When the price hike was opportunistically mobilized by oil companies to manufacture an 'energy crisis' (Mitchell 2012), it seemed

to confirm the *Limits* report's predictions of impending scarcity, providing support for its calls for a 'steady-state' economy (Moll 1991:9).

The Limits to Growth was an intervention in this debate over the shape of the emerging global order. The notion of 'common resources' characterized by global limits provided a powerful counterpoint to the exercise of national sovereignty over resources threatened by OPEC's action (Golub and Townsend 1977). Peccei himself recognized the danger this posed to industry and to the industrialized nations: with "oil becoming a political weapon," he wrote, and "the possibility of the oil syndrome spreading to other raw materials – without doubt, a nerve center of industrial civilization has been exposed" (Peccei 1977:182). The "oil syndrome" here offers a convenient shorthand for the strategic exploitation, on the part of less-powerful nations, of the fact that the system of dependency worked both ways. In contrast to this, Peccei asserted that there is "no ethical and political law which says that all such resources belong solely to the nation in which they happen to exist," warning that "any design for good management and saving of world resources can be thwarted if some human groups stake claims for the priority use of some of them here, and others do the same there… It must be clearly understood that *the growing needs of world population cannot be satisfied by anything short of co-ordinated management of all the planet's resources*" (1969:184-5; original emphasis).

In addition to undermining emerging claims to resource sovereignty, the model's presuppositions supported reductionist arguments that the problems of underdevelopment and resource constraints were rooted in Third World population growth. While neither the authors of *Limits* nor the Club of Rome members intended their critique of growth to be an argument for economic stagnation, the report's calls for global equilibrium were easily

mobilized to argue for a brake on Third World economic development (Gallopín 2001:79). The World3 model presumed that industrialization generated a positive feedback effect on population growth, lowering death rates faster than birth rates and thereby resulting in runaway population growth (Meadows et al. 1972:37). But as Third World critics made clear, the notion of zero growth was patently unacceptable for countries suffering from abject poverty and underdevelopment. In a statement by Third World countries at the Stockholm Conference in 1972,

> We strongly reject models of stagnation, prepared by certain alarmist Western ecologists, industrialists, and computerfans; and assert that holding economic growth per se responsible for environmental ills amounts to a diversion of attention from the real causes of the problem which lie in the profit-motivation of the systems of production in the capitalist world (quoted in Moll 1991:119).

At stake in the environmental debate in which *Limits* intervened was the definition of the environment as an object of political concern, and how it might be mobilized toward divergent political ends. The Stockholm Conference was a formative moment in the movement for a NIEO, giving rise to the Third World Forum (ul Haq 1976). As discussed in Chapter 1, developing countries recognized in the sudden concern for the global environment a new set of political forces that might be made to work either for or against them. Throughout the proceedings, developing country delegates worked to expand the problem of the environment to encompass poverty, underdevelopment, warfare, colonialism, human rights, and structural racism.[56] Tying environmental

[56] As a delegate from Tanzania stated: "The evils of apartheid, racial and colonial oppression, far from being irrelevant, are at the very core of environmental problems in Africa due to the degradation they cause to the human resources by taking away the rights of the many and thereby bringing benefits to only a minority. It is in this vein that Tanzania expects the conference to take a definite stand against such projects as the Cabora Bassa and the proposed Kunene dams whose purpose is to perpetuate a system of human degradation, discrimination and of colonial domination… As these projects envisage the displacement of the indigenous people by the

problems to Palestinian displacement, Jim Crow, Apartheid, the Vietnam War, and the persecution of Muslims in the Philippines, the Libyan delegate claimed that "the conference, besides, cannot ignore… environmental pollution by human bodies who are unfairly killed" (quoted in Rowland 1973:51). Stockholm, and ironically the *Limits* report itself, helped to catalyze a new push for the Third World solidarity that Peccei had considered dead, and testified to a new global situation in which his paternalistic solutions would find no traction.

'Catastrophe or new society?' A Latin American World Model

In this context, the Club of Rome was not the only group to realize the power of computer modeling in articulating a vision for global futures. As part of their publicity campaign, in 1970 the Club had held an early presentation of World3's results in Rio de Janiero (Herrera et al. 1976). The model met with sharp criticism in that meeting, prompting a group of Latin American scholars present to initiate a counter-modeling project at the Bariloche Institute in Argentina. As Gilberto Gallopín, a co-author on the project and the Executive President of the Bariloche Institute, later reflected:

> The LAWM [Latin American World Model] was a response from the South (I would like, but it would be perhaps presumptuous, to call it 'by the South') to the widespread position — mostly supported by the North — that attributed underdevelopment, international problems, and poverty to overpopulation in the developing countries. Our critique of World3 as the first of the global models should be seen in this context. (Gallopín 2001:79)

Whereas World3 had sought to provide an objective picture of absolute physical limits to growth, the LAWM took the opposite approach. With the assertion that all

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settling of foreigners, they are indeed at the very heart of the debasement of man and his environment." Quoted in Rowland 1973:52.

models are inherently normative,[57] the project began from a vision of an ideal society to be attained, and set out to explore the physical basis for such a society. In this sense, 'modeling' referred to both the utopian visioning of possible futures and to the technology through which this vision was articulated: "Thus the conceptual model is a proposal for a new society, and the mathematical model is the instrument through which its material viability is explored" (Herrera et al. 1976:8).

The ideal society proposed by the Bariloche team was an egalitarian one based on the recognition of basic rights to adequate nutrition, housing, health, and education (Herrera et al. 1976:25). Combining a socialist economic system with a democratic political system, its production model was driven by the satisfaction of these basic needs rather than profit, but the definition and determination of these needs would be a matter of collective and democratic decision-making. The model envisioned a planned economy that dispensed with both private and state property, in which the use and management of the means of production would be decided by democratic process. Depending on the activity in question, this democratic process may take place in a variety of institutional forms such as "production units, ad-hoc committees, and/or communes of the state" (26). Planning was therefore not a technocratic exercise dominated by the state or (as for Peccei) a self-appointed global elite, but a democratic exercise.

The ideal society was an egalitarian one on both national and international scales, and a key premise of the project was the importance of regional economic autonomy. Unlike the World3 model, which took a universalizing global perspective that made no

[57] In the first sentence of its published report, the team stated that "Any long-term forecast of the state of humanity is founded on a perception of the world that incorporates a system of values and a concrete ideology." "For this reason," they argued, "it is not justifiable to differentiate between extrapolative and normative models" (Herrera et al. 1976:7).

distinction among regional development trajectories, the LAWM grouped socialist and capitalist nations together as "developed" countries (to the dismay of critics on both sides of the iron curtain)[58], and divided the developing world regionally. Thus the model stressed both the importance of regional collaboration among Third World nations and of their autonomy with regard to the developed world (Herrera et al. 1976:42-3). In this context, international 'equilibrium' referred to the normative goal of equalizing the balance of payments among developed and developing countries (43). Through a submodel that related demographic variables to sociopolitical variables, the LAWM affirmed its working hypothesis that "the only truly adequate way of controlling population growth is by improving basic living conditions" (8). That is, in place of World3's universalizing notion of equilibrium as a global limit on resource extraction and population growth, the LAWM reframed equilibrium to refer to the reversal of the structural dependency and underdevelopment that they argued were constitutive of the prosperity of the affluent countries (19).

Like *The Limits to Growth*, the LAWM was a futurological project in the sense that it articulated possible futures in order to intervene in the governance of the present. But whereas *Limits* devised an extrapolative approach to project a future catastrophe, the LAWM located the catastrophe in the present and sought to examine the material conditions for a wholesale transformation of the global order (Nordhaus 1975; Gallopín 2001). The LAWM did not reject the notion of environmental limits outright, but reframed these as *relative* to a given political-economic system rather than absolute. Estimations of mineral and resource reserves made no sense, the authors argued, if not specified "in relation to a specified economic and technological situation," and even so

[58] See the comments collected in Bruckmann 1976.

could hardly be measured with accuracy (Herrera et al. 1976:28). Likewise, they argued that pollution should not be treated as an inherent side-effect of industrialization, but could be mitigated through a strategy of "ecodevelopment" (37).

In laying out this proposal for a new world system, the significance of computer modeling for the Bariloche team was both ideological and technological (Gallopín [2001:81] referred to its effects as "magical [in an anthropological sense]"). The report argued that dependency had taken the form of the technological superiority of developed countries, which had crystallized a new international division of labor that locked developing countries into volatile and low-value-added export industries (Herrera et al. 1976:20). By advancing the state of the art in systems modeling in Latin America, "The LAWM was also a concrete demonstrate that the South could stand up on equal terms with the most advanced institutions of the North in the discussion of the global problematique" (Gallopin 2001:81).

In the context of a crisis of the postwar balance of powers that had sustained Fordist growth in the industrialized world, *The Limits to Growth* and the LAWM put forward two radically different propositions for world futures. As part of Peccei's broader political project, *Limits* supported a vision of centralized control and decentralized markets,[59] in which a global planning authority would establish the conditions for optimal resource use and balanced competition in a global economy driven by multinational firms, while ensuring an adequate distribution of wealth to appease the restless masses. In contrast, the LAWM reframed equilibrium to refer to a redistribution of political power

[59] Based on the *Limits* report, in 1972 the incoming President of the European Economic Commission recommended a non- socialist "solution" involving "strongly centralised planning and largely decentralised production" (Sicco Mansholt, quoted in Golub and Townsend 1977:207).

and wealth among and within nation-states. Planning in this vision would be a democratic process of determining an alternative and autonomous development path not yet carved out by the global North.

Following Limits, Peccei worked hard to capitalize on that project's success in the changing geopolitical context. As Moll (1991:187) writes, "for the Club the NIEO debate was also a possible carrier of some of their most precious hopes for international cooperation and steps towards facing the global *problematique*." Traveling for three months around Europe, South America, and Africa, Peccei recruited world leaders to participate in an informal meeting with Club members (Moll 1991:181). The meeting was an initial step toward the type of world forum Peccei had envisioned, unencumbered by international negotiations, as well as a response to the Third World critique of *Limits* (see King 1979/2005b:35; Moll 1991:186). Deliberately excluding leaders from the major world powers, the meeting in Salzburg provided a strategic platform for vocal G77 members such as Mexico and Algeria to voice their critique of the existing world system, and to advance their agendas for its transformation (Moll 1991:183).

In response to the Salzburg meeting, Peccei commissioned a study by Jan Tinbergen that was a direct intervention in the NIEO debate. Entitled "Reshaping the International Order" (RIO), the project articulated a social-democratic compromise for appeasing Third World demands without addressing the fundamental redistribution of world power that this would demand. As Cox (1979) argued, the report exemplified "one of the two faces of hegemony" – alongside the monopolistic liberalism of the Trilateral Commission, RIO rejected protectionist strategies on the part of poor countries and

envisioned an expanded free market system based on competitive advantage, but accompanied this with social welfare policies "designed to moderate the negative welfare effects this strategy had hitherto produced" (Cox 1979:275). This compromise approach sought to co-opt the state agendas of developing countries into a new symbiotic relation with multinational firms. As summed up by Samir Amin,

> The fact is that the themes of the new order involve the aspiration to control natural resources and to strengthen national states, which imperialism does not accept. Imperialism would therefore like to substitute for the new order the 'RIO project' (Reshaping of the International Order!) which is an ideological formulation of the need to transfer some of the industries of the centers to the peripheries under the wing of the multinationals (Amin, quoted in Cox 1979:278).

To Peccei's disappointment, neither the RIO project nor any of the Club's subsequent reports would come close to replicating the impact of *Limits*. Substituting "exhortation" for politics (Cox 1979:279), the Club's passionate calls for global cooperation failed to contend with the concrete power relations at work in reshaping the international order. If the collapse of Peccei's "private empire" in Argentina can be seen as a crisis of the social democratic compromise between labor and capital, the RIO project signaled the crisis of this vision on a geopolitical level. With RIO's failure to garner much attention, in subsequent years Peccei led the Club increasingly toward private diplomacy (Moll 1991:194).

Conclusion

Due in large part to Peccei's masterful sense of timing and tireless publicity campaign, *The Limits to Growth* set the terms of debate on both environmental limits and global modeling in the 1970s. But almost as soon as it was released, its technological approach and its ideological message would be rendered obsolete. The field of global

modeling peaked in 1973, and the impact of *Limits* would decrease over the following years (Moll 1991:178). More fundamentally, however, the political agenda out of which *Limits* was born quickly lost touch with the political reality articulated by the 1973 oil crisis and the emerging NIEO movement, as well as the reactionary forces that would move to re-consolidate class power in the neoliberal counteroffensive. As van der Pijl (1993:54) writes,

> Within the reform coalition that temporarily appeared to successfully press for a New International Order, the cadre class in capitalism, which is the product of the socialization of labor and in turn, is oriented to maintaining social cohesion, anticipated the 'moment of expropriation' and hence sought to prevent imbalances and excesses that might set in motion a true revolutionary movement. Yet from the point of view of capital, this anticipatory action was dangerous in itself… Of the broad array of regulatory proposals, ultimately only those survived that were compatible with the sovereignty of capital on a world scale.

The changing geographies of production that Peccei and his contemporaries helped to inaugurate were already implicated in a transformation in which the interests of productive capital in stability and planning would be marginalized by a neoliberal era of financialization dominated by the interests of money capital (van der Pijl and Yurchenko 2014). Peccei's career illustrates the crisis of an alternative vision of globalization that would have imposed the Keynesian compromise on a world scale. At the same time, through his tireless networking and organizing, Peccei was an active force in the construction of the institutional networks through which the transnational capitalist class would become a force "for itself," riven by internal factions that would shape the neoliberal counteroffensive (Carroll and Sapinski 2016).

This chapter has investigated the political context that gave rise to the vision of global futures articulated in *The Limits to Growth* and in which that vision gained political currency. By tracing this history through the career of Aurelio Peccei, I have

argued that the vision of global management he sought to advance with *Limits* was shaped by the shop floor struggles within Fiat's factories, the impact of new technologies on labor and manufacturing, and geopolitical contestations over the shape of an emerging international order. In that context, the articulation of environmental limits to growth served to buttress a paternalistic liberal agenda that would transpose the Keynesian labor-management compromise onto the world scale, reestablishing 'global equilibrium' in the form of balanced competition and coordinated allocation of resources in a new international division of labor driven by MNCs. In a moment of profound indeterminacy over the shape of a new international order, *Limits* envisioned a future that was neither recognizably neoliberal nor liberatory; rather than diagnose the pattern of forces at work in transforming the world system, it took an extrapolative approach, projecting the limits of its Keynesian imaginary into physical limits of the planet as a whole.

Resituating *The Limits to Growth* as an exercise in corporate futurology demonstrates that the political meaning of the environment in the 1970s was an open (geo)political problematic that was fully implicated in struggles over the trajectory of global futures. Both the *Limits* project and the LAWM emerged from the intersection of multiple globalities in the 1960s and 70s, including the global terrain of radical left politics, the geopolitical alliances among Third World nations, the global operations of multinational capital, and the experience of planetary-scale environmental problems. Both of these projects attest not only to the indeterminacy of global trajectories in that historical moment, but also to the significance of futurological visions in transforming socio-ecological futures. In a contemporary moment characterized by the profound uncertainties of climate change (our knowledge of which has been deeply shaped by *The*

Limits to Growth [Edwards 2000]), the practice of futurology has again emerged as an consequential force in the governance of the present (Braun 2015b). Whereas *The Limits to Growth* has eclipsed the Bariloche model in histories of environmental thought, the LAWM's utopian vision not only expands our understanding of the history of the future but also illuminates the "future histories" (Virno 1996) that inflect contemporary environmental thought, and that may open new futurological vistas in the present.

Chapter 3: From 'Nature Constant' to 'Nature Resilient': Ecology and the nature of neoliberalism

In the past two decades the concept of resilience has become a dominant paradigm of global governance, informing theory and policy in areas as widespread as international development, financial regulation, terrorism, risk management, urban planning and disaster recovery (citations). In the field of climate change adaptation and sustainable development, resilience (along with its associated method of "adaptive management") has become an influential discourse for the administration of life on a planetary scale (Nelson 2014). In urban planning and design, resilience is a unifying framework for a variety of interventions designed to enable cities to more effectively respond and adapt to large-scale catastrophic events, from hurricanes to terrorist attacks (Wakefield and Braun in press; Smith 2014:72). For the Resilience Action Initiative, a collaborative endeavor among nine Fortune 500 companies dedicated to incorporating resilience thinking into corporate strategy, resilience is a response to life in an increasingly "turbulent" world, which demands new business strategies and a new social role of the corporation (Kupers 2014). As a predominant framework for the governance of life in the contemporary moment, resilience reframes the problem of security as a matter of flexible adaptation in an environment characterized by turbulent and unpredictable dynamics, in constant anticipation of the incalculable and yet inevitable threat.

Resilience marks a profound shift from the closed-systems ecology of *Limits* and early ecological economics to posit a new ecological ontology characterized by complexity, non-linearity, and multiple equilibria. This chapter revisits the early development of resilience theory in ecologist C.S. Holling's work on resilience at the

International Institute of Applied Systems Analysis (IIASA), where he was head of the Ecology Program from 1973 to 1974 and later director from 1981-1984. Whereas the last chapter showed how a normative vision of ecological stability was extrapolated into a formula for an ecologically-grounded Keynesian equilibrium between capital, labor, and a global state apparatus, here I argue that resilience posed a new response to environmental crisis, one not predicated on maintaining a fixed equilibrium (as in the *Limits* report) nor on fundamentally transforming the global economy (as in the Bariloche model, both of which were presented and debated at IIASA [Bruckmann 1976]). Instead, resilience replaced the reactionary ideal of the steady-state economy with a counter-revolutionary mode of governance that incorporates disturbance as a motor of innovation and growth. Together, these chapters show how the evolution from what we might call first- to second-generation systems ecology registered a new quality of life that demanded new arts of government.[60]

By focusing on Holling's ecological research, I make two interventions in the narrative of counterrevolution proposed by Virno: first, building on the previous chapters, I argue that the counterrevolutionary turn took place in response not only to new forms of labor resistance, but also to new forms of social-ecological connectivity that rendered inadequate Keynesian-era techniques of ecological management. Second, I argue that the counterrevolution is concomitant with the emergence of new biopolitical technologies that diverge from what Foucault described as the 'normalizing society.' I argue that resilience posits a different ontology of life than that which underpins liberal governance, mobilizing rather than mitigating alterity and transforming the relation between the social

[60] This shift intersected with the shift from first- to second-order cybernetics; see von Foerster 1982; Clarke and Hansen 2009; Wolfe 1998. On resilience and the government of "complex life," see Chandler 2014.

body and its outside. The rise of resilience as a strategy for governing "complex life" (Chandler 2014) is central to a new biopolitical paradigm in which the ecological rather than the biological becomes the pervasive model of life processes, and in which the biological risk of contagion is overtaken by the ecological threat of catastrophic system collapse.

This chapter advances the central argument of the dissertation that the production of the environment as an object of governance has been formative of neoliberalism. This does not mean however that resilience was simply an ecological concept that subsequently provided a way of naturalizing the dynamics of economic and social systems (as many critics have argued [e.g. MacKinnon and Derickson 2012; Walker and Cooper 2011]); instead, from the beginning Holling envisioned and developed the concept in an interdisciplinary context as a universal systems language that would address conjoined problems in ecology, economics, and social and institutional management. Nor does it signal some essential fit between resilience and neoliberalism, as has been posited in much of the critical literature (e.g. Walker and Cooper 2011, Evans and Reid 2014). As a counterrevolutionary technology (and a technology of the counterrevolution), the political possibilities of resilience are not constrained to its neoliberal iterations. At IIASA, the concept of resilience was at the center of an international and interdisciplinary research program in which the relation among decentralization, markets, and state planning was not pre-determined. Considering resilience theory to be counterrevolutionary reveals that its alignment with neoliberalism is contingent rather than necessary, and may bring to light possibilities for the subversion of its neoliberal iterations.

I begin by revisiting Foucault's analysis of biopolitics in order to demonstrate how resilience articulates a new ontology of life that is formative of a shift in the way that life is governed with the rise of neoliberalism. However, drawing on Egle Rindzeviciute's (2016) history of systems science at IIASA and Johanna Bockman's (2011) account of market reforms under socialism, I argue that this new governmentality is not specific to neoliberalism; rather it was developed through international collaboration among scientists in socialist and capitalist countries, and deployed on both sides of the iron curtain. I then situate Holling's intervention in the context of ecological thought. Tracing the development of resilience theory at IIASA, I show how resilience was developed from a descriptive account of ecological dynamics into a prescriptive approach for environmental management through interdisciplinary collaboration and exchange among economists, management scientists, and mathematicians (among others) in an international context. I make two main arguments: first, that although resilience would not come into direct contact with the notion of ecosystem services until the 1990s (Dempsey 2016; Gomez-Baggethun 2010), both of these ideas are symptomatic of a broad shift in environmental governance in which the productive *capacities* of ecosystems – rather than simply their products – are the objects of measurement, valuation, and management. Second, I show that resilience was influential to advances in systems analysis much earlier than its mainstreaming in the 1990s, helping to catalyze a break from first-generation theories of closed systems and stable equilibrium to a second generation of systems thought defined by multiple equilibria and a productive relation to alterity. Resilience, I argue, posits a counterrevolutionary response to environmental crisis, developing governance techniques that harness disturbances and uneven dynamics

toward innovation and growth. This counterrevolutionary approach, however, signals that the relation between resilience and neoliberalism is contingent rather than necessary. In the concluding section, I highlight the uneasy fit between the basic tenets of resilience and market governance, arguing that the neoliberal iterations of resilience were not predetermined in its origins.

The biopolitics of resilience

In Foucault's (2003:246) classic descriptions, biopolitical interventions take the form of a convergence of disciplinary technologies focused on the individual with "regulatory mechanisms" that intervene at the level of the population to "establish an equilibrium… and compensate for variations within this general population and its aleatory field." Foucault describes this convergence in terms of the "normalizing society" (Collier 2009:87), "which aims to establish a sort of homeostasis, not by training individuals, but by achieving an overall equilibrium that protects the security of the whole from internal dangers" (Foucault 2003:249).

In his late lectures, Foucault argues that the emergence of biopolitics cannot be understood without reflecting on its historical conditions in liberal governmental reason. Unlike the juridical critiques of state power based on natural right, which called on transcendent principles external to *raison d'Etat*, Foucault argues that liberalism is marked by a principle of limitation to state power that is internal to the objectives and rationality of government itself, based on a certain understanding of 'nature' (2008:10). For Foucault, political economy is the "intellectual instrument, the form of calculation and rationality" that made this self-limitation possible (13), by revealing the operation of 'natural' laws whose operation it was the duty of good government to respect:

[P]olitical economy does not discover natural rights that exist prior to the exercise of governmentality; it discovers a certain naturalness specific to the practice of government itself… The notion of nature will thus be transformed with the appearance of political economy. For political economy, nature is not an original or reserved region on which the exercise of power should not impinge, on pain of being illegitimate. Nature is something that runs under, through, and in the exercise of governmentality… [I]f there is a nature specific to the objects and operations of governmentality, then the consequences of this is that governmental practice can only do what it has to do by respecting this nature (Foucault 2008:15-16).

In this way, Foucault argues that the market becomes a "site of veridiction" within liberalism, through which the 'truth' of good government is revealed. Thus the measure of good government is not: is it legitimate? But rather: is it effective? Foucault thus defines liberalism less as a coherent doctrine than a principle of critique of governmental practice, defined by the questions: Why govern? And: how does one not govern too much?

Foucault unfortunately never returns in these lectures to the problematic of biopolitics and its relation to liberal reason as he promises.[61] I want to suggest, however, that an important mechanism through which the politics of the population were mediated by the institution of the market as a site of veridiction and test of government was 'the economy,' as it has been described in Chapter 1. The health of the economy, measured above all through an expanding GDP, was to an important extent an index of the health of the population, and the mechanisms for fostering the life of the population were exercised through interventions in the economy — for instance via housing market policies, health care markets, demand management, etc. To the extent therefore that the economy served to articulate the politics of life with the market as a site of truth and an expression of

[61] He closes his summary of the lectures with the provocative comment: "What should now be studied, therefore, is the way in which the specific problems of life and population have been posed within a technology of government which, although far from always having been liberal, since the end of the eighteenth century has been constantly haunted by the question of liberalism" (Foucault 2008:323-4).

'natural' laws, its crisis (as described in Chapter 1) also entailed a shift in the mechanisms by which the life of the population could be assured.[62]

The environmental crisis, I argue, was an index of the problems increasingly evident with the economy as a mechanism for securing the life of the population; its constitutive blindness to its own ecological conditions was discovered to pose a series of threats to the health of the social body. On the one hand, these appeared in terms of an existential scarcity of critical resources that presented a limit to economic growth and to the type of truth expressed by the market. On the other hand, they appeared in terms of the daunting complexity of social-ecological processes and their interconnections, which defied predictive strategies and the statistical measures of the normalizing society. These related but distinct aspects of the problem might be described, in the terms used in Chapter 1, as its *environmental* and *ecological* dimensions: 'environmental' in terms of the recognition that those reproductive conditions forming the constitutive outside of the economy could no longer be ignored; and 'ecological' in the broadest sense in which that term came to be used at the time, to describe the dynamics of complex systems in a number of areas, and above all the intersections among social, economic, political, and biophysical processes – in short, a new quality of life that exceeded mechanisms of

[62] As Brian Massumi writes: "From the time of the physiocrats, making life proliferate has meant making the economy grow. Guaranteeing the passage from individual conformity to collective constants could only limit the dynamism of the economy, which in the 20th century came to be seen as predicated on innovation… To maximize innovation, the norms tended by disciplinary power had to loosen to admit a wider gambit of variation and quicker turnover of conformities (2009:156)." Massumi observes that the very articulation between discipline and biopower had already begun to effect this loosening, as the norm itself had emerged as a constant "intrinsic to the biological processes of the human-species population and its innovatory evolution," rather than an something to be externally imposed (156).

normalization.[63] The environment, therefore, posed a challenge to political economy: the truth of the market was not invalidated, but no longer seemed a sufficient measure of effective government.

The response to this posed by ecological economists was in a certain sense a reactionary one, seeking to reassert stability and equilibrium through top-down measures of command-and-control. For ecological economists (as in *The Limits to Growth*), the environment was posited as an external principle of limitation to government, primarily in terms of resource scarcity — due not to historical contingencies but to the fundamental properties of matter (an ontological scarcity of "low-entropy matter-energy" [Daly 1980a:5, 8]).[64] In this regard, the debates that pitted "technological optimists" like Robert Solow and Julian Simon against environmentalists like Daly and Ehrlich can be understood to revolve around the questions of the extent to which the 'truth' of the market was a sufficient measure of effective government, and to which liberalism, as a principle of limitation to governmental action, was compatible with an ecologically-attuned capitalism. Whereas Simon and Solow held that the market would effectively incorporate information about increasingly scarce resources so as to promote their conservation and their replacement by manufactured capital, thereby obviating the need for government intervention, Daly and others argued that the use of markets was necessarily limited by environmental scarcity; they could be relied on to distribute goods, but only within strict limits to population growth and resource exploitation established through extra-economic means, by a government that could act "as a monopolist" on resources (Daly 1980c:339).

[63] Recall Ozbekhan's use of ecology here: "we are confronted with a problematique which is ecosystemic in character" (quoted in Elichirigoity 1999 79).
[64] See Foucault's discussion of natural right as an external limit to *raison d'Etat* (Foucault 2008:6).

Their steady-state economy or "spaceship earth" proposed an intensification of the normalizing society, in which a stable equilibrium would be imposed on an expanded economic system encompassing life on a planetary scale, operating in accordance with what they viewed as natural ecological balance.

As a reactionary response, however, their analysis was already out of touch with contemporary political realities. By posing the environment as an external limit to government action, based on a transcendent principle (ecological balance) rather than a principle internal to liberal reason, its solution was incompatible with liberalism as a critique of government (Daly [1980b:367] described it as a "third way" between capitalism and socialism). Instead, a very different type of response to these urgencies was taking shape, as Foucault indicates in a comment towards the end of his lectures of 1978-9, in his discussion of American neoliberal theory during that period:

> [W]hat appears on the horizon of this kind of analysis is not at all the ideal or project of an exhaustively disciplinary society in which the legal network hemming in individuals is taken over and extended internally by, let's say, normative mechanisms. Nor is it a society in which a mechanism of general normalization and the exclusion of those who cannot be normalized is needed. On the horizon of this analysis we see instead the image, idea, or theme-program of a society in which there is an optimization of systems of difference, in which the field is left open to fluctuating processes, in which minority individuals and practices are tolerated… and finally in which there is an environmental type of intervention instead of the internal subjugation of individuals. I will try to develop some of all this next week (2008, 259-260).

Foucault does not, unfortunately, return to trace these developments in later lectures as he says he will (265, notes 36 and 37). I want to propose however that resilience posed an alternative response to environmental crisis than that proposed by ecological economists and *The Limits to Growth,* one that enabled precisely an "optimization of systems of difference" and an "environmental type of intervention." Resilience posited a new ontology of nature not based on an essential scarcity, but rather

a plenitude of ecological capacities and potentials that were being stifled and mismanaged by attempts to impose equilibrium as an external norm. As described further below, Holling posed the environmental problem in terms of this new nature which demanded new forms of knowledge and strategies of management (where 'management' came to describe any activity of governing, from the scale of the nation state to that of a research institution). In other words, his critique was framed in liberal terms: it was not based on ecological balance as a transcendent moral principle, but on a question of effectivity — what should effective environmental governance involve? How should management work with the dynamics of complex life in order to most effectively foster and direct its inherent capacities?

Stephen Collier (2009:93) has argued that, in Foucault's later lectures, biopolitics does not describe a "governmental logic," but rather "a problem space to be analyzed by tracing the recombinatorial processes through which techniques and technologies of power are reworked and redeployed." Following this reading, Foucault's comments do not mark an epochal shift, in which we have left disciplinary technologies behind, but prompt us to ask how new techniques may be articulated in the 'problem space' of biopower to administer life in ways that diverge from the normalizing society. Collier posits that *thinking* receives a new kind of attention in these lectures: rather than emerging out of a stable episteme that provides their conditions of possibility, significant thinkers "are situated precisely amid upheaval, in sites of problematization in which existing forms have lost their coherence and their purchase in addressing present problems, and in which new forms of understanding and acting have to be invented" (95).

Thought becomes "a driver of recombinatorial processes" in response to practical urgencies (96).

It was just such an urgency to which Holling and other early thinkers of resilience responded. Faced with the failure of normalizing techniques to 'make life proliferate,' systems ecologists combined novel computer modeling techniques and innovations in mathematics, decision theory, management science, and economics to develop new management systems and theoretical tools to contend with the non-linear, non-equilibrium dynamics of life processes. Ecology was of course not the only field where these innovations were taking place; Holling's work was in keeping with broader trends in systems analysis, including second-order cybernetics and related fields (Von Foerster; cite examples). But Holling's work in this area was significant for two reasons: first, as stated above, it posited a new ontology of nature that demanded new strategies of government – what Holling (1975/1982) would call "Nature Resilient" as opposed to "Nature Constant." If as Foucault suggests liberal governmentality relied on a certain understanding of nature and the natural, then the life sciences were a crucial place where these ideas were formulated. The ideas of nature that informed political economy were always in a relation of mutual influence with the natural sciences (Mirowski 1989, 2002), and in the interdisciplinary and collaborative context of IIASA, Holling's work influenced systems analysis in fields ranging from economics to energy policy and urban design. Second, Holling developed concrete strategies and tools for governing this new nature — for working *with* its emergent processes of normation in the absence of total knowledge of the system and predictive power. He did so furthermore in the context of a new international and interdisciplinary institution founded in order to address universal

and global problems across the East-West divide. From the beginning, resilience was seen not only as a property of ecological systems, but as inaugurating a new ontology of nature with ramifications for governance in general. Holling's work thus advanced a liberal critique of environmental governance on the basis of its effects, and proposed resilience as a new nature to which governmental strategies would need to adapt.

If regulatory power views the social body and all threats to it in terms of the biological, seeking to mitigate the risk of "infection" (Foucault 1990:136), I want to suggest that neoliberalism is associated with the emergence of the *ecological* – as a general descriptor for complex relationality – as a primary field of intervention and dominant metaphor for life processes. The new ecology of complex adaptive systems and resilience was thus formative of new biopolitical strategies in the neoliberal era. Revisiting Holling's early work in context sheds important light on how neoliberalism as we know it has come to be partially through efforts to contend with the environment as a political problem.

However, as I explore below, this does not mean that resilience theory had some kind of essential fit with (neo)liberal governance, or that its neoliberal iterations were predetermined in its origins. In this regard Holling's tenure at IIASA becomes significant. As Egle Rindzeviciute (2016) argues in her book *The Power of Systems: How Policy Sciences Opened Up the Cold War World,* IIASA was the first international think tank, establishing an influential model of knowledge production that would proliferate in the following decades. Rindzeviciute (2016:8) writes that research at IIASA was formative of a new "systems-cybernetic governmentality" which "constructed the world as a set of complex and dynamic systems, consisting of different geological, biological, and

technical phenomena, which were also subject to tactical regulation in the same way as population was for Foucault." Moreover, she argues that this systems-cybernetic governmentality was "coproduced" through the collaborative endeavors of Eastern and Western scientists, and that it was not unique to liberal societies. Instead, the technologies of this new governmentality were deployed in context-specific and heterogeneous ways on both sides of the iron curtain, catalyzing processes of liberalization and decentralization within the socialist world.[65]

Similarly, Johanna Bockman (2011) has charted the transnational roots of neoliberalism in the international collaborations of neoclassical and socialist economists from the 1920s through the 1980s. Bockman argues that while neoclassical economics, the liberalization of markets, and decentralized governance are now commonly taken as symptoms of neoliberalism, from its inception neoclassical economics had a formative relation with socialist theory and practice, and there is a long and rich history of socialist efforts to incorporate markets into centralized planning. For instance in 1970s Hungary, reform economists sought to expand competitive markets in leasing (rather than owning) the means of production, and to encourage entrepreneurship and individual accumulation without inheritance (Bockman 2011:162-3). For some of these reform economists, "socialism allowed the realization of the entrepreneurial spirit because the ends of private property and the further development of commodity relations liberated everyone for entrepreneurship" (163). Tracing these developments in Hungary, Yugoslavia, and the USSR, Bockman argues that the equation of markets and decentralization with

[65] Rindzeviciute (2016:8) argues that Foucault's notion of governmentality may well have been informed by developments in systems science: "when the term 'governmentality' began to circulate in the early 1980s, the notion of systems analysis as an *art of governance* was being widely promoted in management education." Thus she argues that foucauldian governmentality studies themselves "might be seen as a part of the system-cybernetic world of governance" (9).

neoliberalism was not a foregone conclusion, but the achievement of a resurgent international Right that obscured these more diverse histories:

> The strategic work of the transnational New Right has helped to spread neoliberalism not because the New Right created the ideas but rather because they successfully exploited and distorted others' ideas. Right-wing activists co-opted social movements and the discussions taking place outside the Cold War dichotomy of capitalism versus socialism to obtain and develop new forms of knowledge… We can see right-wing activists as a reactive force that exploited the creative struggles occupying Cold War liminal spaces. (Bockman 2011:212)

In Virno's terms, we might call this a counterrevolutionary rather than a reactive movement, in the sense that neoliberals in Bockman's account took up ideas, technologies, and innovations that were not their own and turned them in directions that reinforced ruling class interests. Rindzeviciute's and Bockman's historical work helps to shed light on the ambivalent political origins of resilience, and to complicate genealogical lineages that find in it an essential kernel of neoliberal ideology (e.g. Walker and Cooper 2011). Against this backdrop, I will argue below that Holling's research at IIASA became significant precisely because it catalyzed a break from a first generation of systems science oriented toward the maintenance of stable equilibrium and amenable to top-down control, toward a second generation of systems research concerned with multiple equilibria, irreducible uncertainty, and decentralized, adaptive intervention in system dynamics. Through his collaboration with scholars in management sciences, economics, and energy from both East and West, Holling's ideas influenced the way that systems analysis took shape as a new "art of governance" (Rindzeviciute 2016:9) that, while formative of actually-existing neoliberalism, was not defined by it.

Systems theory from stability to resilience

The rise of ecological thought in economics and other fields in the 1960s, explored in earlier chapters, was accompanied and influenced by innovations in the field of ecology itself. Through efforts to mathematically model ecosystem dynamics, ecology became an important field for the advancement in systems theory and complexity in multiple scientific fields. These early efforts, exemplified by the work of R.C. Lewontin (1969) and R.M. May (1972), retained this basic framework of equilibrium theory which dominated in both ecology and economics. Treating systems as bounded entities, they were based on two primary assumptions:

> (1) that a system would generally persist in form and function (unless, of course, humans perturbed it) and (2) that a system would recover to its former equilibrium state after disturbances. Implicit to this was the notion of global or stable equilibrium, such as population or ecosystem carrying capacity (Gunderson and Allen 2010:xiv-xv).

Models and management practices based on stability were concerned with achieving constancy in the amplitude and frequency of oscillations around a 'normal' equilibrium (as in a traditional model of predator-prey dynamics), such that a system was considered more stable the smaller its fluctuations around this norm. Stability theory informed a style of management that sought to maintain a stable equilibrium through external controls and standard rates of resource extraction. For instance, Maximum Sustained Yield (MSY), the primary strategy for fisheries management, was based on the idea that by harvesting the surplus production of fish in a given time period the overall population could be maintained at a relatively constant size. This ecological imaginary of stability was fundamental to ecological thought in the 1960s as it permeated other fields and popular culture, shaping ideas of natural ecological balance. Ecological economists, the authors of *The Limits to Growth,* and neo-Malthusians like Paul Ehrlich (1968)

expanded this notion to the planet as a whole, and advocated environmental strategies based on the notion that stable equilibrium could (and should) be rationally planned and, if necessary, coercively maintained.

In a seminal 1973 paper, C.S. Holling introduced the concept of resilience as an explicit counter to the notion of stability, arguing that such theories misrepresented ecological systems in terms of the mechanical models of classical physics (1973a:1).[66] Holling demonstrated that equilibrium models, prioritizing stability above all else, encounter a paradox in which increased diversity leads to more complex and thus less stable ecological systems (1973a:19). Based on his research into spruce budworm outbreaks in the forests of British Columbia, Holling argued that systems have multiple equilibria or 'domains of attraction;' of concern is therefore not the time it takes an ecosystem to return to its previous state following a disruption (termed later by Holling (1996) 'engineering resilience'), but the degree of stress it can undergo before it 'flips' into an alternative domain (Holling 1973a:10). The resilience perspective thus deemphasized the quantitative relations between population numbers in an ecosystem, and attended instead to the qualitative relations between species and their capacity to resist extinction. As Holling described, in a system "continually confronted by the unexpected, the constancy of its behavior becomes less important than the persistence of the relationships. Attention shifts, therefore, to the qualitative and to questions of existence [of a species] or not" (1973a:1).

Central to the notion of resilience was the idea that species extinction resulted from crossing critical 'thresholds' in the determinate variables of a domain of attraction,

[66] As Walker and Cooper (2011) point out, Holling's critique mirrored Hayek's critique of economics, which Hayek argued was slavish in its tendency to simply apply the theories of the physical sciences to economic systems.

for example the decline of population numbers of a critical species past a certain limit, or a change in environmental factors influencing the size of the domain of attraction. Holling (1973a:20) therefore proposed two measures of resilience: the "overall area of the domain of attraction;" and the threshold value closest to equilibrium beyond which the system would be pushed into a new domain. The notion of thresholds, coupled with the idea that a system's development is driven by positive feedbacks among its constituent elements, posited that system change was abrupt and unpredictable – catastrophic – rather than gradual and linear. Moreover, gradual changes to one element of a system – such as incremental decline in the population of a given species – could trigger sudden and catastrophic change once a threshold was surpassed and feedbacks drove the development of all system components along a new trajectory.

The identification of thresholds did not, however, encourage management for stability as a means of avoiding these critical limits. One of Holling's key points was that a system may be highly resilient precisely because it is highly unstable. Using the example of spruce budworm outbreaks, Holling argued that while fluctuations in the budworm population in relation to predators and parasites were highly unstable, viewed in the long term "these very fluctuations are essential features that maintain persistence of the budworm, together with its natural enemies and its host and associated trees" (Holling 1973a:14). In other words, instability and disturbance are not only inevitable, but also essential to generating resilient capacities (18).

In this way Holling's resilience theory was an explicit critique of industrial-era management practices such as MSY. If instability generates resilience, management systems that sought to maintain stability tended to decrease system resilience. Holling

(1973a:18) thus noted that "it is not surprising… that the commercial fishery systems of the Great Lakes have provided a vivid example of the sensitivity of ecological systems to disruption by man, for they represent climatically buffered, fairly homogeneous and self-contained systems with relatively low variability and hence high stability and low resilience." These natural conditions were exacerbated by management for MSY, which, Holling argued, tended to undermine system resilience and increase vulnerability to environmental stresses.

Resilience required a fundamentally new approach to resource management, one not concerned with quantifiable outcomes but with the support and promotion of adaptive capacities, mimicking evolutionary dynamics themselves:

> In Slobodkin's terms evolution is like a game, but a distinctive one in which the only payoff is to stay in the game. Therefore, a major strategy selected is not one maximizing either efficiency or a particular reward, but one which allows persistence by maintaining flexibility above all else (Holling 1973a:18).

Holling's adaptive management strategy would replace prediction with opportunism, "emphasiz[ing] the need to keep options open" and to "design systems that can absorb and accommodate future events in whatever unexpected form they may take" (21). Whereas Holling's contemporaries in ecological economics attempted to domesticate new forms of ecological and environmental risk through an imposition of stability in the form of the "steady-state economy," resilience theory sought to mobilize the uncertainty generated by non-linear dynamics as a catalyst for innovation and growth. It was this early work that brought Holling to IIASA, where he would develop the management implications of resilience theory in an explicitly globalist context dedicated to East-West collaboration on systems science. In this way, resilience theory was central to the formation of what Egle Rindzeviciute (2016) has called a "system-cybernetic

governmentality" that extended across the iron curtain. Like that of Aurelio Peccei, Holling's work also participated in an ongoing trend in systems research in which the language of 'management' came to operate as a general term for governance, and in which the management sciences are increasingly central to advances in other scientific fields. In other words, with the rise of the systems-cybernetic governmentality Rindzeviciute describes we also witness a general becoming-management of government.

Holling at IIASA

No one voluntarily defines systems analysis. It can be represented as a new concept of understanding or a new technique of managing any complex system. Or it can be claimed to be simply a new label for an established way of thinking and doing. And ecology is the same. There was a time when ecology meant the study and management of the interrelations between organisms in their environment. Now it means so many things to so many people its definition and relevance are as confused as that of systems analysis. It is ironic justice that two such indefinable subjects have been so hailed as the panaceas for the problems of an industrialized world.

– C.S. Holling, 1973[67]

The International Institute of Applied Systems Analysis (IIASA) arose out of the global vision and international advocacy of Aurelio Peccei. One of the central pillars of Peccei's vision of a new global order was a detente between the US and USSR, specifically to facilitate collaborative engagement on applied systems research. Scientific cooperation was both a means to this goal and an end in itself: as he wrote in his 1969 book *The Chasm Ahead*, one of three crucial conditions for the success of "Project 1969," which would inaugurate a new system of global governance through a World Forum led by the Great Four (the US and Canada, Europe, USSR, and Japan), was "some quiet, off-the-record talks about the future between Washington and Moscow," which may "start by contacts at a purely scientific level" (Peccei 1969:266). Moreover, the research conducted

[67] In IIASA 1973:1.

by such a center would lay the groundwork for understanding the types of global problems that the World Forum should address, in a process that "corresponds to the air survey of an unmapped land in the reinvestment study for a big project" (266). Peccei broached the idea of a center for East-West collaboration on systems analysis at the White House as early as 1965, while finalizing the first Fiat contract with the Soviet Union (Pauli 1987:67). McGeorge Bundy, assistant and advisor to Presidents Kennedy and Johnson, was involved in these discussions, and later announced at a press conference that he would be working as Johnson's personal representative to explore "the possibility of establishing an international center to study the common problems of advanced societies" (Pauli 1987:67). Peccei helped to facilitate the process over the next six years, using his personal contacts to organize a 1969 meeting between Bundy and the Soviet vice-chairman of Science and Technology, Jermen Gvishiani (Pauli 1987:68), where the Soviet representative expressed his government's dedication to the project (Bundy 1969a). In the interest of a broader project of "bridge building" between the US and USSR, a research center appeared to both sides as a relatively neutral, low-publicity, "non-governmental" route to this goal (Bundy 1969b).

At a subsequent meeting that May among scientists from several nations central to the project, the main contours of the center's institutional orientation and focus became discernible: that it would host researchers for short periods of 2-3 years, during which time they would be free to pursue projects of their own interest (Dorfman 1969); that it be non-political; and that it take a "problem orientation" rather than a methodological focus, in the sense that the research would be organized around problems of mutual concern to researchers in different fields (Bower 1969; Bellman 1969). A common theme in these

early discussions was an interest in "specific tractable aspects of universal problems" that are common to advanced industrial societies, and in particular an interest in the "technological and economic aspects of the environmental control problem" (Bower 1969). These areas of focus would be clarified in the following years, and work at IIASA would center on two classes of problems: 1) "universal" problems applicable to virtually all industrial societies; and 2) "global" problems that exceeded international boundaries and demanded global-scale analysis.

It was in the context of this effort to construct a new international institution dedicated to interdisciplinary research on applied systems analysis, as a means to facilitate international relations, that Holling developed his early work on resilience. In this way, resilience was explicitly envisioned as a universal theory of system dynamics that was relevant to problems in a number of fields and within the frameworks of both market economies and socialist planning. Holling joined IIASA in July 1973 as head of the Ecology Project as part of the institute's first cohort, along with team members from UBC, including Bill Clark and Dixon Jones. He describes a congenial and collaborative atmosphere full of ski lessons and practical jokes, including the humorous Ralph Yorque society, the name of which would serve as a pseudonym for the collaborative work of researchers across IIASA projects (Holling, no date). Holling's initial proposal for work at IIASA was focused on the planning and policy implications of resilience: how the theory of multiple equilibria might be applied to a new style of systems management that "emphasizes resilience and the maintaining of open options" (Holling 1973b:3). As he had in his seminal paper on resilience, Holling described a historical shift that

necessitated a new approach, in which human intervention in ecological dynamics had reduced system resilience:

> Up to now the resilience of these systems has allowed us to operate on the presumption of knowledge with the consequences of our ignorance being absorbed by the resilience. Now that the resilience has contracted, traditional approaches to planning might well generate unexpected consequences that are more frequent, more profound and more global. The resilience concept provides a way to develop a planning framework that explicitly recognizes the area of our ignorance rather than the area of our knowledge (ibid.).

In Holling's narrative, resilience posits a new ontology of complex life (Chandler 2014) that has been misunderstood by previous management approaches, and which in turn requires a new epistemological orientation. The result of this misunderstanding is an ineffective and counterproductive approach to resource management that undermines the ability of complex life to reproduce itself, ultimately threatening the social processes it underpins. A management approach adequate to complex life would act on the basis of what it does not know rather than on the basis of knowledge. This is a theme that Holling would stress repeatedly in his work at IIASA and after. As a new ontology of nature, even in this early proposal resilience was not constrained to ecological systems, and the project would involve a broad review of system dynamics drawing from empirical examples in the areas of ecology, economics, and cultural anthropology (ibid.).

The ecology project was to become one of the most productive and successful projects of IIASA's early years (IIASA's first Director Howard Raiffa [2011:97] described it as "one of our best") (Rindzeviciute 2016:99; Schrickel 2014). Despite initial criticism from Gvishiani and other representatives of Eastern member countries that the project focused too many resources on a problem specific to one country (the spruce budworm in Canada), Raiffa and others defended the work on the grounds that its

methodological sophistication would be transferable across IIASA projects (Raiffa 2011:111). For this reason the project attracted the participation of the top IIASA scientists in this early period, including Tjalling Koopmans from Yale, who would win the Nobel prize in economics during his IIASA tenure; George Dantzig from Stanford, the originator of the simplex algorithm and the father of linear programming, who served as leader of IIASA's Methodology Project (and who both Raiffa and Koopmans agreed should have shared Koopmans' Nobel [Raiffa 2011:211; Mirowski 2002:289]); and Alan Manne, also from Stanford, a leading energy economist (Raiffa 2011:112; Rindzeviciute 2016). As Raiffa (2011:111) writes, Koopmans, Dantzig, and Manne "for a year or so became budworm experts."

By addressing formal problems of unstable system behavior with multiple equilibria, Holling's work brought ecological theory to the forefront of advances in differential topology, catastrophe theory, and mathematical modeling. Mathematicians in IIASA's Methodology Program "recognized the immediate connections" between Holling's phase portraits and the global theory of differential equations, while Koopmans noted the close resemblance to new fixed-point algorithms in economics which corresponded to Holling's equilibrium points (Grümm 1977:5). In 1975 Koopmans organized and chaired an international conference that explored the relevance of Holling's work to mathematical problems in the areas of meteorology, climatology, economics, and chemistry, among others (Grümm 1977; Grümm 1975). At the workshop, members of the Ecology Program worked in collaboration with scientists from Eastern and Western member countries on the formal problems presented by resilience dynamics. The workshop inspired further research in climatological modeling and chemical

evolution at the University of Vienna, MIT, and the Frei Universität Berlin. It also solidified the centrality of resilience research to other projects at IIASA, primarily the Energy and Methodology programs (Grümm 1977:6).

Strengthening the interdisciplinary applications of resilience was a key focus of Holling's work at IIASA. As Dixon Jones (1977:1) later wrote, "[o]ur goal while there was to unite the best techniques of ecological modeling, of mathematical analysis, and of optimization and decision theory to see how far we could go towards developing rational tools to aid resource managers and decision-makers." In a planning conference that first year that brought together international scientists to guide the direction of IIASA's ecology research, the links between resilience research and work in game theory, participatory modeling, urban design, energy systems, and water resources were already being forged (IIASA 1973). In his summary of the proceedings, Holling wrote that the study of complex systems dynamics through ecosystem behavior was not only central to the ecology project, but "also underlie[s] every other conceptual, methodological or applied project conceivable for IIASA" (Holling 1973c:7). Holling argued that the resilience research was central to both the global and universal objectives of IIASA: pointing again to a historical shift in which ignorance regarding ecosystem dynamics had led to a contraction of resilience globally, Holling argued that new forms of ecosystem management were essential to addressing the types of global problems with which the institute was chiefly concerned, and that IIASA was uniquely positioned to push ecological research away from local-scale problems toward "a rigorous science of global ecology" (5). At the same time, the dynamics of stability, instability, control, and resilience displayed in ecosystems were universal qualities of complex systems, such that

new ways of managing complex ecosystems bore direct relevance to other fields. At that conference, the seeds were planted for much of the interdisciplinary work that would be pursued in the coming years. For instance the Proposed Research Program for Management of Urban Systems, included in the conference proceedings, identified the goal of maximizing resilience as a central new focus of urban design research to begin in 1974: “the most important contribution of this work would be to help shift the mind-set of present-day economic and physical planners away from single-point 'optimal' or equilibrium-centered modes of thought” (IIASA 1973:124).

A key point of consensus from this planning conference was the need to translate resilience from a descriptive model into new environmental indicators and management approaches that took account of non-linear dynamics (IIASA 1973:28). Holling articulated this need in terms of a shift in environmentalism: a move away from what he described as the "more intemperate extravagances of the recent concern for ecological issues," which "have passed" (Holling 1974:1). Holling was harsh in his critique of “eco-freak” (1) environmentalism and its antagonistic stance toward business. He argued that “narrow solutions” such as banning DDT or opposing freeways and dams were misguided; as responses to the “new emergencies” in environmental politics, they were “as shortsightedly ad hoc as their [the new emergencies’] original causes” (3). In contrast, Holling described a new role for ecology in “adjudicat[ing] some of the inevitable conflicts between economic needs and environmental (ecological) protection:”

> These conflicts do not imply that polluters are necessarily evil and greedy; we are not so naive as to crusade wholly in the name of generations yet unborn and to march off to battle against politicians and captains of industry. Our analysis is directed at those who would study ecological currents and forces, who would ride them piggy-back rather than subdue them to any end, however noble. It is directed at those who would undertake ecological engineering simply because it may be the most cost-effective engineering for

certain laudable commercial enterprises, not merely because it is the gentlest, the most humane, the most natural, or (somehow) the most acceptable. Our objective is not merely to preserve ecosystems
(whatever that means) because it is fashionable to do so, but rather to encourage the systems to work with us (Fiering and Holling1974:2).

Rejecting a moral critique, Holling frames the "new science of ecological management/engineering" (Holling 1974:1) as a utilitarian one that integrates economics and ecology in order to develop practical techniques for cultivating and harnessing ecological capacities. However, the approach to this integration was very different from that proposed by ecological economists: rather than natural equilibrium imposing external constraints, for Holling economics provided a model of rationality to be applied to environmental decision-making. Holling argued that, on the basis of innovations in applied ecology (especially research on fisheries and pests), mathematics (especially differential and difference equations), and computer modeling, the next steps necessary for the "marriage between ecology and economics" to be "effectively consummated" involved integrating techniques from the management sciences, especially policy analysis and decision theory (Holling 1974:2-3). This would enable ecology to progress beyond description to become a prescriptive science.

Holling took the first steps toward this new science in collaboration with the engineer and mathematician Myron Fiering to develop new environmental standards and indicators of environmental quality based on resilience. Diverging from the trend toward totalizing global models (a topic of some controversy at IIASA),[68] Fiering and Holling

[68] As Howard Raiffa (2011:111) commented, while many popular observers confused "IIASA-to-be" with the Club of Rome, global modelling was controversial at IIASA. While Peccei was favored this approach as the Italian council member of IIASA, along with council members from Canada, Poland, and the USSR, the US and UK were very much against, "fueled by scathing remarks by Nobelists Robert Solow and Kenneth Arrow." Raiffa too was "a skeptic about huge global models."

developed methods for distilling complex ecosystem behaviors into their key elements, in order to create a library of 'modules' that could replicate a range of possible system behaviors — from stable equilibrium to highly unstable, resilient structures. Borrowing IIASA's terms, these efforts could be described as shifting the focus of modeling from a global to a universal perspective, abandoning the possibility for a totalizing picture of the complete system in favor of a streamlined catalog of universal types of system behavior, which could be effectively modeled with a minimum number of variables. In contrast to a previous generation of ecological models, Fiering and Holling (1974) defined indicators in terms of functional *roles* in the ecosystem rather than individual *species*. As they wrote, "[s]ignificant changes in roles occur only when the system is significantly stressed, even while there are, or can be, wide temporal and spatial shifts in the species in the absence of stress" (4).

This shift from a focus on species to roles opened up a broader description of 'normal' ecosystem behaviors, rejecting the imposition of stable, single-equilibrium as an external norm in favor of a deeper understanding of the emergent normativity of systems themselves. At the same time, it also opened up new prescriptive approaches for working with this normativity (or, as they put it, "encourag[ing] the systems to work with us"). There was no reason to presuppose, they argued, that a previous system state was desirable; a passage beyond a resilience threshold into a new stability domain may be preferable: "It might also happen that the optimal strategy in the event of such a flip [over a resilience threshold] is the acceleration, by selective seeding or killing of organisms, of convergence to the new domain" (Fiering and Holling 1974:9). They referred to this approach as "Ecological Engineering through the utilization of an Environmental Zoo"

(10), the "zoo" here meaning a reserve army "from which it would be feasible to re-seed damaged ecosystems with organisms of appropriate types, in numbers sufficient to trigger rapid recovery of homeostasis" (or, as in the passage above, to facilitate a shift to a new equilibrium) (Fiering 1973:278). Within a resilience framework desirable system behavior is not dictated by any external notion of a 'natural' system state, but is ultimately a matter of cost – understanding system resilience enables us to assess how cost effective it may be to try to maintain the system in any given state deemed desirable by decision-makers (18-20; 30).

As described in this early work, Holling's resilience theory, and the adaptive management strategy that he would develop through the work at IIASA, shifted the object of ecosystem management from individual species to the *relational* qualities and capacities of ecosystems to grow, change, and produce desired outcomes. In other words, resilience acts on what Spinoza calls *nature naturans* rather than *nature naturata* – nature as *process* rather than product (see also Wakefield and Braun forthcoming). It works with ecosystems' emergent capacities in order to better exploit those capacities and harness their creative force toward societal goals. As suggested above, Holling's work advanced a critique of environmental management based on its effects, positing a new ontology of nature to which governance would have to adapt and advancing concrete strategies toward this end.

If the early literature on ecosystem services turned attention to the economic outcomes of ecosystem functions (rather than stocks), resilience theory systematized the dynamics underpinning these functions and developed a comprehensive strategy for their

management.[69] In the 1974 Ecology project Status Report, Holling and colleagues describe natural resources in terms of a "capital inventory," whose quantity and quality determine the resilience of the system and its associated policies (SR-74-2-EC:60). In an interesting parallel to the idea of "pollution absorption capacity," Holling offered the example that land used for recreational development "is drawn from a reserve of a certain size and with certain intrinsic qualities for absorbing recreation. These quantities and qualities of the remaining reserve should be measured by adding a resilience dimension to existing recreational indicators" (ibid.). Thus while these areas of thought would not explicitly come together until the 1990s (Dempsey DATE; Gomez-Baggethun?), both resilience and ecosystem services were part of a broader shift in environmental governance that prioritized measuring and managing ecosystem capacities rather than resource stocks, and in which the object of environmental management became not so much individual species as social-ecological relations.

By developing strategies for the governance of life that act on relations rather than individuals, and that work to redirect rather than reduce aberrant tendencies, resilience demonstrates how the transformations in governance that Foucault identified with relation to human populations also involved new ways of governing nonhuman populations. But these were not simply parallel developments; rather the life to be governed by these new strategies cut across the division between society and

[69] While the concepts of resilience and ecosystem services did not come into explicit contact until the 1990s, at a series of workshops at the Beijer Institute in Stockholm (Dempsey 2016), we can see both of these discourses as products of a moment in which the focus of governance shifts to ecosystems as a set of capacities to be harnessed and measured, rather than nature as static product. This is not to say that nature's capacities were never managed in the past, but that they become an explicit object of government and an end in themselves rather than a means to maximizing environmental products.

environment. As he would describe in an early volume on global change, understanding resilience requires a holistic perspective on system– environment relations:

> The timing and spatial extent of the pulses [of disturbance that determine a system's resilience] emerge from the interaction between external events and an internally generated rhythm of stability/instability. Industrial societies are changing the spatial and temporal patterns of these external events. Spatial impacts are more homogeneous; temporal patterns are accelerated. An understanding of impacts of global change therefore requires a framework to connect the understanding developed here for ecosystem dynamics to that developed for global biogeochemical changes on the one hand and societal developments on the other hand. There are transfers of energy, material, and information among all three (Holling [1984?] 2010:98-9).

The disturbances that affect system resilience are not exclusively external, but are generated in the border space between the system and its outside, a boundary that is itself the product of an interactive relation. From this perspective, the discourse of 'environmental crisis' gains new significance, as a crisis of the very boundary between an economic interior and its reproductive outside, between the social body and its environment. As a biopolitical technology resilience transforms the relation between the social body and its environment, playing on unpredictable dynamics generated at the interface between a system's interior and exterior in order to foster growth and innovation. As Isabel Schrickel (2014:15, my translation) writes, resilience is translates the descriptive account of ecosystem dynamics into a new approach to governance in general: it is "on the one hand discovered as an emergent property of ecosystems, [and] on the other hand can be understood as an environmental embedding of governmental practices in social and economic systems."

A defining feature of resilience, and a key point of intersection with other fields at IIASA, was a new way of understanding and dealing with uncertainty. In a 1974 paper "Notes Toward a Science of Ecological Management," Holling distinguished among four

types of uncertainty, ranging from incomplete knowledge of ecological functions and social objectives to "qualitative unknowns" stemming from non-deterministic nature itself. As Holling (1974:4-5) wrote,

> The basic rules underlying linked economic-ecological systems can change. Unexpected species can suddenly appear and dramatically alter ecosystem structure. Unexpected economic changes can do the same — witness the observed and potential impact of the energy shortage on food production. And the one-in-a-thousand year flood or drought is as likely to occur this year as any other. In the same way, prescriptive aspects of management can experience equally unpredictable changes. Human objectives which seem so clear at the moment can and do dramatically shift, leaving society committed to policies and systems that cannot themselves shift to meet these new needs.

The "unknown" for Holling was not a matter of insufficient knowledge, but was rooted in an ontological indeterminacy that made striving for (or worse, presuming) complete knowledge of a system impossible.[70] For Holling this indeterminacy was synonymous with nature itself: he wrote that it was impossible to simply "engineer nature, (i.e. the unknown) out of the equation" (Holling 1974:4).[71] This required management strategies that prioritized adaptability based on the presumption that unpredictable change would occur. It also meant that the manager or decision-maker was no longer external to the system, but that decision-making processes were part of the dynamics of the system itself, defining its possible trajectories.

It was on this topic of management under conditions of irreducible, non-probabilistic uncertainty that catalyzed many of resilience's interdisciplinary connections, in part through an informal "resilience group" involving several young scholars (Schrickel 2014:16). David E. Bell, a member of IIASA's Methodology Project trained in

[70] David Chandler (2017) distinguishes "simple complexity" from "general complexity" on the basis of this shift in an understanding of uncertainty.

[71] Here Holling echoes Spinoza's (in)famous formula "God, or Nature." Like Spinoza, for Holling it is the interconnection of all things – in his terms, their complexity – that is the source of nature's indeterminacy.

Operations Research at MIT and who would later become a pioneer in the field of Multi-Criteria Decision Making at Harvard Business School, took his first foray into decision analysis through an examination of preferences for forest states among leaders of the budworm project. Bell (1977:417) wrote in a paper presented at an international IIASA conference on decision-making under uncertainty in 1975 that the study demonstrated to him the applicability of decision analysis for non-monetary situations. Among the ecology group, it catalyzed interest and engagement in decision-analysis for handling complex problems (Bell 1977:416). Through IIASA, these formal approaches to decision analysis, deeply inflected by Neoclassical economics, were deliberately developed through East-West international exchange in ways that were relevant to both socialist and capitalist societies (Bell, Keeney, & Raiffa 1977).

The development of new approaches to knowledge production and decision-making would become central to Holling's adaptive management approach. As he wrote with Fiering in their early paper on the subject, "[environmental] standards are not exogenous to the system but an integral part of our decision process" (Fiering and Holling 1974:3).[72] Holling was an early experimenter with collaborative gaming and experimental workshops "to explore the unknown and to build the essential bridges between methods, disciplines, and institutions" for addressing complex problems (Holling and Chambers 1973:20). The goal of such games was for the workshop itself to develop resilience; for Holling, this intuitive experience of resilience was essential to cultivating an

[72] In this way, again, Holling's resilience theory can be placed in the context of the shift within systems thinking between first-order cybernetics (which presumed an external observer) and second-order cybernetics (in which the observer was considered in a recursive and mutually-constitutive relation with the system observed).

understanding of the concept.[73] This workshop approach was further developed by Holling and Walters at IIASA, and would become a defining feature of the adaptive management approach as it was later codified (Waltner-Toews 2004:47; Holling 1978, 1979). Alternating workshops and research periods would enable participants to "continuously review and modify" their models in light of changing conditions and policy goals. "This sets the stage for an ongoing, evolving program rather than a one-shot attack, and it also makes the most of programs that cause unforeseen problems," thereby transforming failures into productive learning experiences (IIASA 1979). Schrickel (2014:14) links Holling's resilience workshops with the media ecology of Marshall McLuhan, and with the social gaming of Buckminster Fuller: not only did media theory take up ecological concepts, she points out, but new media strategies also shaped ecological knowledge itself. At the same time, Holling's approach can be seen as part of the emerging science of scenario planning now widely used in environmental modeling, business planning, engineering, and numerous other areas; in a 1975 visit to IIASA Jimmy Davidson, the Head of Group Planning at Royal Dutch Shell and early developer of the company's influential scenarios approach, was inspired by the concept of resilience as a framework for understanding socio-technical systems (Kupers 2014:10).[74]

One of the strongest of the interdisciplinary connections that emerged around resilience was between the Ecology Project and the Energy Project, the latter spearheaded by Wolf Häfele from the Karlsruhe Nuclear Research Center in West Germany, who also

[73] Gaming is still part of resilience pedagogy in areas besides ecological management; see van der Meyden (2014) on the Nexus! resilience game developed by Shell Oil as part of the Resilience Action Initiative, now used in the 100 Resilient Cities initiative and other venues designed to propagate 'resilience thinking' (Kupers 2016).
[74] On Shell's scenarios, see Zalik 2010; Wilkinson and Kupers 2014.

served as Deputy Director of IIASA. Häfele, a strong advocate of nuclear energy,[75] was preoccupied with the problem of "hypotheticality" — the idea that socio-technological systems had developed to the point at which the prospect of catastrophic disaster had rendered trial-and-error approaches to engineering infeasible. As Holling and colleagues summarized, "we are locked in a world of hypotheses because we dare not test our hypotheses" (Jones, Holling, and Peterman 1975:3). For Häfele (1973), this situation called for formalized debate regarding large-scale technological projects along with new technical methods of determining acceptable risk. Holling and Häfele immediately saw a resonance between the notions of hypothetically and resilience. As they wrote in an invitation to participants in a workshop on Resilience, Hypotheticality, and Option Foreclosure in 1975, "Each concept, for instance, is centrally concerned with understanding the nature and implications of the *unknown* (as distinct from the merely uncertain) in various aspects of applied systems analysis," and each "breaks with trial-and-error as a sufficient paradigm for program development" (Holling, Häfele, and Walters 1975:3, original emphasis).[76] For resilience, the challenge was to develop this descriptive paradigm into concrete guidance on system design beyond the realm of ecological engineering, to socio-technical systems in general (Clark 1975:16).

Schrickel (2014) argues that Häfele latched onto resilience as a strategic discourse for selling nuclear energy in the midst of West Germany's powerful antinuclear movement, portraying atomic power as part of a resilient energy system. She argues that the topic was a point of continual tension between Holling and Häfele and within the

[75] Schrickel (2014:18) notes that Häfele was one of the most controversial politicians in West Germany at that time.
[76] Bill Clark (1975) described the goal of the workshop as "establishing a 'taxonomy of the unknown'."

resilience group, and Schrickel finds in Holling's work implicit critiques of Häfele's take-up of the concept. As summarized in the proceedings of the 1975 conference, Holling stated that the overall aim of his work was to design " 'a world without hypothetically:' not to design yet more coping strategies that dug us all in deeper, but to prescribe approaches that would make the consideration of hypotheticality irrelevant altogether. In this sense, he saw the work of many engineers, even (and perhaps especially) the most visionary, as antithetical to his own goals" (ibid:8)." Nevertheless, Häfele would continue to invoke the resilience concept to argue against small-scale renewable energy over the following years (e.g. Häfele 1981), and they continued to collaborate with the aim of finding common ground among the concepts after Holling had returned to UBC, organizing a Resilience Workshop together at IIASA in 1976 (Häfele, Balinski & Holling 1975).

Their disagreement centered on what Holling saw as the necessary and generative role of crisis in fostering resilient systems. This comes through in an early exchange among Holling and other collaborators on the ecology project, with the British management scholar and cyberneticist Stafford Beer (who designed the Cybersyn economic planning system for Salvador Allende) and the mathematician John Casti (who would later lead a IIASA initiative on Extreme Events in Human Society). The exchange centered on the use of catastrophe theory, a branch of topology in mathematics, for anticipating and managing disaster in large systems and organizations. In introducing the problem, Beer and Casti (1975:1) move seamlessly between examples in the realm of ecology, urban governance, social services, and business management. In a model very similar to resilience, they suggest that catastrophe results when a system moves through a

"cusp" in phase space and slips into a different configuration. The problem for management is how to effectively direct investment into trajectories that will not result in catastrophe, manifested by the collapse of key factors in the system (such as, in their examples, a species in an ecosystem, or workers' morale in a business). Citing a paper on resource management by Carl Walters of the Ecology Program, Beer and Casti advocate for management approaches that do not avoid this cusp region, but strive to effectively inhabit it:

> Then the hypothesis is that successful managers BROADEN THE CUSP. This increases danger and instability; but according to the hypothesis it is exactly by operating in this zone that successful managers provide themselves with the sensitivity to the risk of disaster that enables them to adjust their investment to avert disasters in unidentified collapsing factors. In other words, we are postulating a self-adapting feedback system for continuous policy adaptation in successful management, that depends on a broad cusp. (Beer and Casti 1975:21)

In their response, Holling and colleagues argued that despite their willingness to dance on the edge of the cusp, Beer and Casti remained inappropriately catastrophe-averse. Reemphasizing the relevance of catastrophe theory to resilience and environmental management (1, 6), they critiqued the tendency to avoid large-scale catastrophes my minimizing disaster risk (here, in an apparent response to Häfele, they raised the example of nuclear energy). The topic was taken up at the 1975 conference on Resilience, Hypotheticality, and Option foreclosure: "What Beer and Casti missed," according to the reporter's summary of Holling's comments, "was that engineering to broaden the stability domain carried with it the inescapable consequence of deepening the catastrophe manifold – in other words, according to Holling, of moving the system into a domain of a smaller probability of a much larger disaster. Thus the Beer-Casti

prescription favored, unwittingly, a move away from resilience and toward hypotheticality" (Swain 1975:9).[77]

As opposed to Beer and Casti's flexible manager, Jones, Holling and Peterman offered the figure of the "entrepreneur" as the one who "need[s] risks, need[s] unexpected events for personal enrichment," but who also gives "high value" to such events "almost irrespective of benefits" (Jones, Holling and Peterman 1975:4).[78] Whereas Beer and Casti portrayed a flexible manager learning to avoid catastrophe by constantly operating on its brink, Jones, Holling, and Peterman argued that the periodic experience of catastrophe was essential to the total system's learning, to the extent that "there might well be a place in environmental, institutional or societal management for *disaster design* — periodic 'mini-disasters' that prevent the evolution of inflexibility" (6; my emphasis).

The emphasis on a productive relation to disaster and disturbance would be strengthened in Holling's subsequent work on resilience; in his 1978 edited volume *Adaptive Environmental Assessment and Management*, the first major output to synthesize a resilient management agenda, Holling (1978:11; original emphasis) defined resilience as the capacity "to absorb and *utilize* (or even benefit from) change." This was further developed in Holling's influential concept of the *adaptive cycle*, which has been

[77] In the midst of a discussion on the topic, Holling expressed that his objections were not merely technical, but entailed a different orientation to life in general: "Holling broke in to say that all these suggestions were retrograde -- essentially back in the 'engineering for safety' paradigm. What about (he asked rhetorically) all those folk who value, indeed live off, a series of mini-disasters? Fishermen, entrepreneurs, and Howard Raiffa's hiring policies [at IIASA] were all built around the deliberate planning of serendipity. He denounced us all, and decision theorists in particular, for wanting to take the fun out of life" (Swain 1975:12).

[78] In considering the move from stability to resilience in terms of a shift in the art of government as 'management,' it is interesting to compare Holling's comments here to Peccei, who "described himself as a 'manager' in direct antithesis to the image of the entrepreneur" (Pauli 1987:60). The entrepreneur was for Peccei too motivated by personal gain to maintain the rational perspective of an astute manager; for this reason he refused the offer of company stock during his tenure at Olivetti (Pauli 1987:57).

called the "principle common denominator of resilience research" (Hornborg 2013:118). The adaptive cycle models the dynamical evolution of social and ecological systems over time, as system "capital" – which can be anything from "nutrients, biomass, and physical structure" in an ecosystem to "skills, networks of human relationships, and mutual trust" in a social system – moves through four phases: exploitation, conservation, revolt, and reorganization (Holling 2001:394). As capital is accumulated during the conservation phase in stable forms, the system becomes less complex and more rigid; Holling offers the examples of General Motors, AT&T, and IBM, effectively describing an overaccumulation of fixed capital resulting in increased rigidity, setting the stage for a crisis fomented by "agents of disturbance" from within or outside of a system such as "wind, fire, disease" for "societal revolts" (394-5). Following this "revolt" phase, reorganization occurs through moments of "creative destruction" in which "previously accumulated mutations, inventions, external invaders, and capital can become reassorted into novel combinations, some of which nucleate opportunity" (395). While a more resilient system may reorganize itself on a higher level (maintaining its defining relationships in a changed form), a less resilient system may give way to a fundamentally new configuration.

In the adaptive cycle, resilience is quite literally a counterrevolutionary property that enables controlling elements to maintain a system's defining characteristics through periods of crisis. Whereas steady-state theorists proposed a reactionary response that advocated non-growth in response to the evident failures of the Keynesian-Neoclassical growth paradigm, Holling reframed growth as uneven and non-linear, an unevenness that could become the very source of dynamism and change. Further, he worked to develop

concrete strategies for designing systems that were capable of co-opting "agents of disturbance" as resources for system evolution.

But if the adaptive cycle, as Walker and Cooper (2011) argue, appears to offer an ontology of capital accumulation strikingly close to the post-equilibrium economics of Friedrich von Hayek, this does not mean that its 'fit' with neoliberal strategy is necessary or secure. As argued above, Holling's ideas about resilience and its associated management strategies took shape in a context in which new technologies of governance through systems analysis, market liberalization, and decentralized government were being deployed in both socialist and capitalist countries. We can therefore understand resilience as not only a counterrevolutionary technology, but also a technology of the counterrevolution, in the sense that its central insights regarding adaptive management and multiple equilibria were taken up toward alternately conservative or progressive ends.

Conclusion

In his reflection on IIASA's first five years, Roger Levien, IIASA's second director, summarized the importance of the ecology project:

> the approach developed and the analytical issues addressed turned out to have relevance far beyond the specific subject matter of their application… Holling and his colleagues addressed complexities that systems analysts generally ignore: multiple conflicting decisionmakers; multiple conflicting objectives; intertemporal and inter-generational trade-offs; and the design of strategies that deal with the irreducible uncertainty of the real world by, for example, avoiding premature foreclosure of options or by being 'resilient'… These ideas, spawned in the Ecology Project, influenced other projects as well, particularly Energy and Methodology" (Quoted in Schrickel 2014:17).

The influence of Holling's resilience theory on environmental governance has been well-documented, as it has become foundational to the work of international institutions through the influence of the Resilience Alliance and the Stockholm Resilience Centre,

both of which have carried resilience theory into the present and further developed the strategy of adaptive management (Walker and Cooper 2011; Nelson 2014). However, less well-acknowledged is the central role played by Holling's theories to early advances in systems analysis and its application in governance more broadly. Through Holling's collaborations with Häfele, his work shaped new understandings of energy systems and new strategies for contending with risk; as Alan McDonald (no date), an alum of the energy program, recalled, IIASA was known internationally for having "some of the world's best work on risk acceptance" with regard to nuclear energy in the 1970s. Holling's observations of multiple equilibrium dynamics posed new problems that helped to demonstrate the relevance of advances in topology and differential equations for similar problems in economics, climatology, chemistry, and other fields, and brought ecology to the cutting edge of complex systems modeling. His forays into decision analysis helped to pave the way for later applications of decision theory to environmental problems (see Chapter 4), while his experimental workshops for adaptive management pioneered new methods for knowledge production about unknowable futures.

These interdisciplinary and international origins of resilience show that new understandings of nonhuman nature, and new ways of contending with environmental problems, were formative of new forms of governance in the present. But they also trouble reductive accounts of resilience that find its political implications prefigured in its origins. If there is an empirical diversity of resiliences in the present (Anderson 2015), then this diversity was also present in the origins of the concept. In this way the genealogy presented here runs counter to critical approaches that find in resilience as essential identity with neoliberalism. These accounts tend to be characterized by an

analogical style of critique, in which resilience is distilled to a defining essence, whose damning resemblances to key tenets of neoliberal governance can then be charted. A prime example of this is Jeremy Walker and Melinda Cooper's (2011) widely-cited article on the "Genealogies of Resilience," which traces the commonalities among Holling's early resilience theory and Friedrich von Hayek's vision of post-equilibrium markets. For Walker and Cooper, the "proximity between the emergent discourse of 'resilience' and contemporary neoliberal doctrines" signals that resilience is politically incapacitating, capable of incorporating all deviance as an immanent motor of growth (see also Evans and Reid 2014). But this analogical critique has in fact little to do with the genealogy of resilience as such. What it tells us is that Holling and Hayek shared related, though distinct, political concerns (including a critique of the *Limits to Growth* and related Malthusianisms), and that they were both inspired – like virtually all major thinkers of the time – by advances in complexity science. We could just as easily see the proximity between these projects as signaling the ambivalence of resilience and complexity, their ability to be put to work toward divergent political ends, rather than signally some essential fit between resilience and neoliberal theory.

An alternative vision of resilience appears through Holling's reflections on a visit to China that he took during his first year at IIASA, the same year he published his seminal paper on resilience. Holling described the communal structure of Chinese agriculture as a highly resilient system characterized by local self-sufficiency and decentralization that enabled responsive governance: "Behind the cant and slogans," he wrote, "lies a brilliantly structured and humane strategy which emphasizes persistence not efficiency, equality not diversity, and self sufficiency not dependence" (Holling 1973d:2). In an

essay entitled “On Making a Marriage, an Institute, or a Society,” Holling used China as an example of a resilient organization whose strategy and tactics were relevant to governance problems within institutions of all kinds (including IIASA). Holling praised the model of internally-diversified, locally self-sufficient communes and villages, which he noted violated received economic doctrines of comparative advantage, efficiency, and economies of scale (Holling 1973e). By prioritizing self-sufficiency at the small scale, the Chinese system, in Holling’s eyes, was better able than the West to foster innovation and independence on the part of local units, while minimizing the cost of failure for society as a whole (Holling 1973e:3-4). He contrasted this to British imperial policy in Burma, where privatization and market reforms combined with hierarchical governance created a maladaptive, inflexible system that could not respond to drought or other emergencies (4). For Holling, these examples suggested lessons for IIASA’s own leadership and for the application of systems analysis as a governance strategy:

> True strategic failure occurs when solutions lie in other, isolated hands. That is the route which leads to systems analysis as the panacea of the world’s ills — glue for the unglued. The successful strategy then makes possible the easy exploration of alternate tactics. One important set are the tactics of initiating a fresh concept and direction within a system which by definition resists change. And these tactics must dance between the extremes of dictatorial fiat and subtle deviousness, both of which are seeds for disaster. (Holling 1973e:5)

In other words, systems analysis for Holing was not simply a management directive to be imposed from the outside, but a strategy of experimentation emphasizing localized control in ways that do not necessary accord with neoliberal imperatives of “responsibility without power” (MacKinnon and Derickson 2012), nor with doctrines of efficiency and profit maximization. Instead, Holling’s early work at IIASA demonstrates not only the concept’s influence on multiple fields, but also indicates that resilient forms

of life might have taken shape in a diversity of possible futures. This does not invalidate critiques of neoliberal resilience in the present, but it does turn attention to the tensions and inconsistencies that emerge as notions of resilience are tacked onto neoliberal policy imperatives, and the multiple political rationalities that might operate within a resilience framework.

By way of illustration, I want to offer a closing anecdote from the Resilience Action Initiative mentioned in the introduction to this chapter, a corporate collaboration for resilience research initiated in at Davos in 2012 by Shell Oil. In an interview Roland Kupers, a former Shell employee and the consultant hired to lead the initiative, reflected on the disjuncture between corporate strategy and resilience theory. "From a societal perspective," he argued, "what a company is is an entity that's completely traded off any resilience for efficiency… they've carved out some part of reality, cut it off as much as possible from everything around it to make it literally non-complex, and then they optimize the hell out of that particular patch of reality" (Kupers 2016). Despite their best efforts, corporations remain, in Kupers' words, "deeply simple organizations" that are far more brittle than they appear. Echoing Holling, Kupers called on an example from his own experience in his early career at AT&T's Bell Labs, which, in his description, failed to adapt to the telecom revolution that the company itself had initiated. He predicted that "Shell and Exxon are going to go out of business too… And not because they don't understand what's going on in terms of the energy transition, but because they can't do anything about it. So they're not very resilient." For this reason, Kupers (2016) suggested that cultivating societal resilience requires social welfare systems that can support individuals through these upheavals.

Rather than finding a unified essence of resilience that is obscured by its expression in diverse contexts, I want to suggest that the uneasy alliances between resilience and neoliberalism reveal the latter's counterrevolutionary origins and mode of operation. The articulations of resilience with technologies of government that we have come to associate with neoliberalism – including market rule, devolution of governance institutions, and a hostility to centralized control – do not so much signal a successful foreclosure of the political, but indicate the impossibility of that closure, and the presence of an excessive political potential immanent to apparatuses of control. In other words, the diversity of resiliences should also cause us to take seriously the diversity (and contingency) of neoliberalisms. This history suggests that, rather than charting the analogical resemblances between resilience and neoliberal theory, tracing the diverse ways in which resilience is taken up, reworked, and put to use to advance specifically neoliberal ends may in fact reveal their *dis*semblances.

Chapter 4: The nature of value: *Homo economicus* in the wake of the *Exxon Valdez*

Just past midnight on March 24th, 1989, the Exxon oil tanker *Valdez* struck a reef on its way out of port from Valdez, Alaska. In under an hour, close to 11 million gallons of North Slope crude were unleashed into Alaska's Prince William Sound. The spectacular devastation wreaked by the spill was widely understood to have been exacerbated by the concurrent failures of the Coast Guard, Exxon, and relevant state agencies to stop the oil from spreading. As acknowledged by the Chair of the Coast Guard Marine Safety Division in the weeks following the disaster, both "federal and state contingency plans were inadequate to contain the oil spill from the *Exxon Valdez*" (Exxon Valdez Oil Spill 1989, 2).

But the efforts to contain the effects of the *Valdez* went far beyond the Alaskan coast. Occurring at a pivotal moment for US environmental regulation, the oil industry, environmental movement, and the financial sector, the *Valdez* disaster can be seen as a constitutive moment in the neoliberal turn in which the problem of environmental valuation came to the center of state and corporate concern. Following the spill, oil companies poured significant resources into influencing the terms on which the value of nature would be assessed in environmental damage suits. Their efforts to limit the scope of environmental values that would be legible to public policy called into question the conceptual foundations and practical utility of neoclassical theories of value, and generated far-reaching effects for ongoing processes of environmental re-regulation and financialization.

Whereas the previous chapters reevaluated the genealogies of ecosystem services and natural capital, global modeling, and systems ecology through the conjuncture of environmental crisis, this chapter jumps ahead to examine how the problem of environmental valuation became a matter of concern in response to the political, economic, and ecological urgencies presented by the *Valdez*. In this way the chapter demonstrates that neoliberal environmentalism did not take shape all at once as a coherent program; rather its various elements came together in response to specific urgencies. The *Valdez* disaster can be considered one of these formative moments, in which environmental values and the new economic approaches to behavior discussed in Chapter 1 (pioneered by Gary Becker, and implicit within the early notions of ecosystem services) became a matter of public policy. At the same time, however, the problem of environmental valuation following *Valdez* reverberated beyond the realm of environmental policy. This chapter advances the argument of the dissertation by showing that the problem of nature's value is a formative one through which the strategies and techniques for the governance of life (both human and nonhuman) in neoliberalism have been forged.

The chapter begins from regulatory debates over environmental valuation under the Oil Pollution Act of 1990 (OPA) in order to trace, in Kristin Ross's (2015) terms, the "afterlife" of *Valdez*. As Ross writes, afterlife denotes "[n]ot the memory of the event or its legacy… but its *prolongation*," the reverberations that are "part and parcel of the event itself" (6). In the debates I examine here, which took place in a NOAA-sponsored expert panel tasked with assessing environmental valuation methods for damage assessment

under the OPA, environmental valuation was posed as a political problem that concerned the role of economics in public policy and the relation between corporate and state control of environmental regulation. These debates not only shaped the kinds of methodologies that are used to assess the value of so-called ecosystem services and other forms of natural capital in the present, but also raised fundamental questions about economic theory and its role in public policy.

I begin by placing the *Valdez* spill in the historical context of US environmental regulation and energy policy, the environmental movement, and corporate accountability concerns in the petroleum and chemical industries, demonstrating that containing the effects of *Valdez* was of crucial importance both to government agencies and to the oil industry. In this context, I explore how environmental valuation took shape as a political problem through the NOAA panel debates. Following Foucault (2008), I argue that these debates contended with a defining problematic of neoliberalism: namely, the nature of *homo economicus* (economic human) as a model of economic rationality, and the extent of this figure's applicability to social behavior in general. The problem of translating environmental values into monetary terms, I argue, was not simply about applying market logics to the natural world, but was also about redefining economic rationality and the behaviors to which that rationality applies.

Oil companies' efforts to contain the political and financial fallout from *Valdez* therefore had implications beyond environmental policy. In their efforts to discredit methods for measuring non-market environmental values, oil companies sponsored research that would become foundational to the behavioral revolution in economics. The

political backlash from the spill also helped to spur the nascent trend toward corporate social responsibility and shareholder activism, which has been instrumental in reestablishing corporate sovereignty in the neoliberal moment by transferring state regulatory functions onto the private sector. Finally, the legal ramifications of *Valdez* provided an inadvertent opportunity for financial innovation, catalyzing the first credit default swap and initiating the era of credit derivatives that has qualitatively transformed the role of finance in society. The afterlife of *Valdez* thereby permeates a contemporary economy characterized by new metrics to rationalize environmental values, new corporate-NGO partnerships to capitalize on these values, and the increasingly-financialized forms of their circulation. In this way the chapter shows the uneven temporalities of the counterrevolution as an ongoing process of crisis and containment, through which we inherit a "future history" not only of revolution but also of disaster.

Timothy Mitchell (2012) has argued that the politics of oil were formative of the way that the environment emerged as a political object: on the one hand, catastrophic oil spills such as the 1969 offshore blowout near Santa Barbara, California served as powerful catalysts for environmental organizing. On the other hand, oil companies latched onto certain environmental concerns – such as fossil fuel scarcity and the environmental impacts of nuclear power – in order to produce an 'energy crisis' and to manipulate the price of oil in their favor (Mitchell 2012:190-192). Mitchell (191) writes that, "[l]ike the economy, the environment was not simply as aspect of external reality, against which the oil industry had to contend. It was a set of forces and calculations that rival groups attempted to mobilize." Central to the production of the environment and the

way that it was mobilized by oil companies was the creation of new methods for calculating the price of scarce resources under the purview of the new field of 'resource economics,' inaugurated by economist Robert Solow. For Mitchell, these new calculative technologies served to legitimate market rule precisely at the moment when the Fordist-Keynesian paradigm of the economy was breaking down in theory and in economic reality. "For Solow and many of his fellow economists," Mitchell argues, "market devices were intended as an alternative to democratic methods of governing matters of public concern, by converting them into matters of private regulation by those with the resources to operate as market agents" (196).

However, Mitchell's portrayal of this mobilization of the environment as a deliberate and coherent strategy on the part of oil companies and mainstream economists risks simplifying the causal narrative to the point that, at its most stark, the production of the environment reads almost as a conspiracy theory. Building on and departing from Mitchell's work, I offer the *Valdez* case as an example of how the problem of containing environmental politics by mobilizing the environment in the interests of fossil capital was not resolved in the 1970s, but persists into the present in ways that are not understandable as the foreseen results of a deliberate strategy. This case also shows how the efforts of oil companies and government agencies to "mobilize" the environment took place on the terrain of value. That is, rendering the environment subject to market rule was not simply about expanding market logics in opposition to state regulation, but also about redefining the notion of value itself and the terms on which it operated in public policy. The problem of environmental valuation in the wake of *Valdez* signaled a broader political crisis for the

oil industry that threatened its control of the regulatory process and introduced new, potentially incalculable risks to the production and transport of oil. The struggle to contend with this problem played out (in part) through debates over the CV method. Revisiting the history of CV in the context of *Valdez* suggests that environmental valuation is a political problem through which the viability of market rule is negotiated, and in which exchange-value is continually called into question as an adequate universal abstraction.

Rationalizing environmental values

Since its inception, environmental economics has struggled to reconcile neoclassical welfare economics with the problems of measuring the value of public environmental resources not traded in markets. Welfare economics locates the source of value in the increase in individual welfare derived from goods and services (i.e. their utility), values which are 'revealed' in market prices. This *revealed preference* approach poses obvious limits to an analysis of the economic value of public, non-market goods and altruistic behavior – problems which come to the fore in environmental conservation. In particular, since Krutilla's (1967) pioneering work (discussed in Chapter 1), environmental economics contends with the notion of *existence values* (or, more paradoxically, non-use values) – the idea that people may derive an increase in welfare from the mere existence of a resource that they do not intend to use.

For Michael Hanemann (1994, 37), an early pioneer of non-market valuation, the notion of existence values implies an approach to economics as "not just the study of markets, but more generally the study of human preferences and behavior." The idea is

that, even without a market, "there still exists a latent demand curve that perhaps can be teased out through other means" (ibid). At the core of environmental economics is therefore not simply the problem of quantifying the biophysical functions of ecosystems (e.g. carbon sequestration), but also the economic analysis of human behavior.

It is precisely this expanded economic analysis of behavior that, for Foucault (2008), defines the theoretical innovation of American neoliberalism. As he writes, "the essential epistemological transformation of the neo-liberal analyses is their claim to change what constituted in fact the object, or domain of objects, the general field of reference of economic analysis," from the mechanisms of production and exchange to "the study and analysis of the way in which scarce means are allocated to competing ends" (Foucault 2008, 222). In other words, for neoliberal thinkers – exemplified for Foucault by the work of Gary Becker (see Chapter 1) – economics "is no longer the analysis of the historical logic of processes; it is the analysis of the internal rationality, the strategic programming of individuals' activity" (223).

At stake in this redefinition of economic science, for Foucault, is the transformation of market rationality into a "principle of intelligibility" for social behavior in general (Foucualt 2008, 243). For instance in Becker's notion of human capital, economic behavior describes not only the allocation of scarce resources to alternate ends, but also any behavior that "responds systematically to modifications in the variables of the environment" (Foucault 2008, 269). These theories were paralleled by the research of psychologists such as B. F. Skinner, who experimented with the "contingencies of reinforcement" that would enable "repeatable behavior to be selected" (287, note 8).

Foucault thus describes neoliberalism as a kind of environmental power (259), referring not to the nonhuman environment as such, but to a mode of government that acts indirectly on the subject by modulating the feedbacks from its environment in order to condition behavior.

We could therefore say that two meanings of 'neoliberal environmentalism' intersect in the effort to comprehend environmental values in economic terms. While Foucault focuses on the implications of this behavioral analysis for the theory of human capital and criminal justice, its consequences were equally significant in the realm of environmental economics and environmental policy. Environmental economists such as V. Kerry Smith applied Becker's household production function to environmental resources, analyzing recreation in terms of the production of "service flows" from which the individual derives utility or satisfaction (Smith 1975/1996, 89).[79] Departing from established methodology, environmental economists pioneered the use of surveys to construct artificial decision-making contexts that elicit individuals' 'willingness to pay' for, e.g., the existence of a sea otter or a coastal ecosystem, or their 'willingness to accept' as compensation for its destruction.. These methods are termed *contingent valuation* techniques because the values they reveal are "contingent upon the constructed or simulated market presented in the survey" (Portney 1994, 3). In CV research, the control of environmental "contingencies" as described by Skinner is transposed onto a simulated decision-making environment through which hypothetical behavior can be

[79] The contemporary notion of "ecosystem services" is, in this light, not simply a concept invented by conservationists in order to better communicate with economists (as the story is often told), but is also embedded in a broader shift in economics toward an understanding of the totality of economic life in terms of the productive consumption of services.

elicited and comprehended in economic terms. The primary debates among economists concerned the extent to which these simulated markets could replicate actual economic behavior. As Veisten (2007, 226) writes, the response to CV from some sections of the discipline mirrored the hostility to Becker's initial forays into the field of behavior in the 1950s.

In addition to the challenge it posed to some core neoclassical assumptions, however, it was the material implications of CV for environmental policy and liability that transformed these theoretical disputes into a political controversy (Veisten 2007). As elaborated below, the history of CV shows how the problem of applying market relations as a principle of intelligibility for social behavior was worked out not solely within neoliberal scholarship, but rather through a diversity of scholarly fields in response to specific urgencies that demanded new conceptual and methodological tools. As the next section explores, the *Exxon Valdez* presented just such an urgency.

The politics of environmental valuation in the wake of *Valdez*

CV would "come to meet the real world" in the mid-1980s, when a series of regulatory changes under the Clean Water Act and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, commonly known as the Superfund Act) included existence values among the environmental damages for which federal trustees could seek compensation from polluters (Portney 1994, 6-7). In 1989, existence values were at the center of a decisive case before the D.C. Court of Appeals, *Ohio v. DOI*, which took up the question of whether they should be given equal weight to market values in damage assessments. While the case was argued in February of that

year, before it could be decided, the *Valdez* spill starkly revealed the stakes of the question for regulated industries. In its decision that July, the court ruled unanimously that existence values be given equal weight alongside conventional use-values in damage assessments, and upheld the use of CV to assess these values (*Ohio v. DOI*, 34, 44).

As Portney (1994, 7) writes, the coincidence of the spill with the *Ohio* decision "focused the attention of Exxon and many other companies on existence values and the contingent valuation method." Their concerns were borne out when the State of Alaska commissioned a CV survey on the impact of the *Valdez* that provided much of the basis for its case against Exxon (Carson et al. 1992; Carson and Haneman 2005, 840). Due to ongoing litigation the study was not made available to Congress or the public, but the Washington Post reported that it estimated existence values alone at $3 billion (Lancaster 1991).

For many members of Congress and environmental groups, these figures and the secrecy surrounding them testified to the inadequacy of the approximately $1 billion settlement between Exxon and state and federal trustees and provided grounds for the settlement's rejection.[80] This controversy, along with the legal support provided by the *Ohio* decision, was fundamental to the Oil Pollution Act of 1990 (OPA), Congress's legislative response to *Valdez*. The OPA mandated compensation for existence values that could be "reliably measured," and the drafting of its rules "became the next battlefield on which to fight about the legitimacy of existence values and the CV method" (Portney 1994, 7).

[80] See discussions in Congressional hearings Budgetary Implications (1991) and Recently Negotiated Settlement (1991).

The OPA ended a nearly 14-year legislative stalemate over how best to integrate the patchwork of regulations, anchored by CERCLA, that pertained to oil spills (Birkland and Lawrence 2002). Despite growing opposition to the 10,000 oil spills throughout the 1970s, the oil industry managed to maintain control of resource politics and environmental regulations throughout that decade and most of the 1980s, with spill events receiving limited news coverage and congressional hearings taking place in industry-friendly committees (Kurtz 2004). This was due in part to the industry's success in transforming OPEC's oil price hike of 1973-74 into an 'energy crisis' (Mitchell 2012), and in part to the increasing dependence of state and federal governments on oil revenues (Kurtz 2004). At the time the *Valdez* struck reef, oil revenue had come to provide 85% of the income for the State of Alaska and was the second-greatest source of income for the federal government, exceeded only by the Internal Revenue Service (Gramling and Freudenberg 1992).

The *Valdez* disaster marked a decisive departure from this political status quo. Media coverage was unprecedented of the extreme devastation created by the spill,[81] starkly portraying the ineptitude of Exxon's and government clean-up efforts. Combined with the fact that the dramatic decline in oil prices during the 1980s had made the energy crisis a "distant memory", industry's established narratives of effective self-regulation and an impending oil scarcity were no longer politically effective (Kurtz 2004:215). Whereas the industry had previously been able to keep spill-related hearings under the jurisdiction of relatively friendly committees, the *Valdez* spill saw an unprecedented

[81] Birkland and Lawrence (2002) cite over 1500 print news stories and 161 network news stories related to the spill in 1989 alone.

increase in the number of hearings compared to any spill since 1968, as well as in the number of government agencies involved in these hearings – many of which had long been working to strengthen spill regulations (Kurtz 2004). With the passage of the OPA, comprehensive guidelines regarding liability for damages and cleanup costs were established for the first time at the federal level (Kurtz 2004, Birkland 1998). Regardless of its long-term implications for environmental protection, the OPA was a decisive shift in spill policy that signaled the effective end to industry control over the regulatory process (Kurtz 2004, Birkland 1998).

The *Valdez* disaster also "exemplified the maturation of the environmental movement" which, in contrast to previous decades, now had the institutional capacity to mobilize significant resources and broad mainstream support (Kurtz 2004, 210). In 1989 the level of participation of pro-environmental protection groups in spill-related congressional hearings was more than four times higher than in any year since 1968 (209). Citizen attendance at spill hearings reached record highs, and a boycott of Exxon and public demonstrations in front of Exxon offices exemplified the industry's deepening legitimacy crisis. The environmental movement also built on the longstanding local opposition to Exxon's activities in Alaska. From the perspective of local politics, the event itself was not an unpredictable catastrophe, but the culmination of a long and contested history that linked resource exploitation to indigenous politics (Gramling and Freudenberg 1992, 179). Beginning in 1968 with the discovery of commercially-viable deposits in Prudhoe Bay, plans for a Trans-Alaska Pipeline faced intense and effective opposition from indigenous groups, environmental organizations, fishing industry

associations, and other constituencies. By the time construction on the pipeline that would carry North Slope crude to Valdez harbor began in 1974, there was already a well-established network of activists from a number of different constituencies with experience and demonstrated effectiveness in challenging oil industry operations. Following the Valdez, the work of environmental organizations was buttressed by that of labor unions, marine pilots' associations, indigenous tribes, and fishing industry groups, many of whom mobilized quickly – both in clean-up efforts and in the policy arena – to expose Exxon's negligence (Birkland 1998, 9; Kurtz 2004, 211).

Grassroots mobilizations were accompanied by a new form of activism empowered by the shareholder value revolution of the 1980s. Advocates for environmentally-responsible investing seized on the disaster, forming the Coalition for Environmentally Responsible Economies (CERES) to launch an aggressive shareholder advocacy campaign for adoption of the "Valdez Principles" – a landmark voluntary standard of corporate environmental accountability – at the annual meetings of most major oil and chemical companies (Hoffman 2001, 110). While the principles met with resistance from Exxon and other companies, they also signaled the increasing influence of shareholder activism on corporate strategy (131). By May 1991, the president of the American Petroleum Institute (API) named "the environment the top issue for US industry" (quoted in Hoffman 2001, 118). In contrast to the grassroots and antagonistic spirit of 1970, Earth Day 1990 was defined by the self-conscious participation of the chemical and oil industries, and the trade journal *Chemical Week* saw fit to declare that "Earth Day is every day for us" (quoted in Hoffman and Ocasio 2001, 431).

The importance of regaining control of the environmental narrative went beyond spill policy. For the new Bush administration, 1989 was supposed to be the year that the Alaskan National Wildlife Refuge would finally be opened to oil exploration, unlocking a significant new source of revenue for oil companies as well as federal and state governments (Gramling and Freudenberg 1992, 191). The *Valdez* spill abruptly curtailed these plans (Gramling and Freudenberg 1992; Birkland and Lawrence 2002, 21). At a May 1989 Conference on International Energy Security sponsored in part by the US Department of Energy and the Independent Petroleum Association of America, Alaskan senator Ted Stevens lamented that "Before the Exxon Valdez went aground there was a glimmer of hope that the United States would finally put in place a long-term energy strategy to deal with increased demand and reduced domestic supply," which would have included exploration in ANWR and a resumption of lease sales in the Outer Continental Shelf (quoted in Miller 1989:7). Containing the political effects of the *Valdez* disaster was therefore not only important for the oil industry, but also for federal and state agencies with entrenched interests in domestic oil production.

It was in the context of this politically- and economically-consequential legitimacy crisis that oil companies entered the debate about CV. Unable to prevent existence values from being recognized in the new law, the oil industry turned to discrediting the methods used to measure them. Between the passage of the OPA and the release of the final rules in 1994, Exxon, API, and affiliated companies funded research, conferences, and industry reports aimed at discrediting the CV method, and generated an immense volume of comments and expert witness testimony to feed into the rulemaking

process.[82] As one economist summarized in his comments on an April 1992 conference showcasing industry-supported research and hosted by Exxon's consulting firm Cambridge Economics, "The basic conclusion of all the [conference] papers is that CV should be discarded as a public-policy tool for determining economic damages to the environment. In some papers, the conclusion is even stronger: that CV should be discarded as a public-policy tool – period" (Plott 1993, 467).

The nature of value: the NOAA expert panel on contingent valuation

Some of the comments that I've read or overheard in some of our public meetings almost seem to indicate that we at NOAA might as well attempt to very clearly and simply explain the word 'infinity.' While I do not characterize our situation as quite that bleak or impossible, it does provide a rather interesting mental image, as we comprehend our task.

– Randall Luthi, Senior Counselor for Environmental Regulations, NOAA General Council[83]

Given intense pressures from industry and environmental advocates over the issue of CV, in 1992 NOAA convened an expert panel led by Nobel Prize-winning economists Robert Solow and Kenneth Arrow to inform the OPA rulemaking process. Because the law explicitly required compensation for lost non-use values where they could be reliably measured, the panel was instructed to begin from the premise that such values exist, and only to address the question of whether CV provided a viable method of measuring them.

In August of that year the panel held a public meeting in which it heard testimony from 22 experts in the field, at least half of whom were funded by Exxon, API, or a coalition of corporations that included Dupont and 3M (Jerry A. Hausman, in NOAA

[82] Examples of these studies include Cummings and Harrison (1993) and those collected in Hausman (1993). See also Carson and Hanemann (2005, 840).
[83] In NOAA 1992, 10.

1992, 35). In their comments, critics of CV called on Exxon-sponsored research to question both the source and nature of the values reflected in CV surveys. CV was "not measuring economic preferences," they said, but more subjective and fluid "ethical values" which did not conform to the standards of economic rationality and were thus not relevant to damage assessments (Hausman, in NOAA 1992, 36, 43). One Exxon-funded study that was the object of significant discussion seemed to demonstrate that different groups of respondents, when asked to place a dollar value on birds killed in oil ponds, placed similar values on 2,000 and 20,000 birds, respectively. Because respondents' willingness-to-pay to avoid bird death did not reflect the expected marginal increase in consumer surplus per bird life spared, CV opponents argued that the value expressed in CV studies did not emanate from the resource in question, but from the "warm glow" respondents received from the transaction itself as a charitable act. If the value was actually located in the transaction, it did not reflect the existence value of the resource and could not be used as a guide for damage assessment, which should not be based on ethical concerns but only "self-interested economic preferences" (Hausman, in NOAA 1992, 48; Diamond, in NOAA 1992, 58-9).

A second line of argument proposed that preferences were not revealed but constructed through the survey process itself. According to one economist with Cambridge Economics, CV amounts to "using opinion polls to set values in society" (Hausman, in NOAA 1992, 36). Commentators argued over whether respondents were too unfamiliar with the "goods" in question to attach an economic value to them, or whether the CV survey could recreate the "perfect information" that economists would

expect in a market situation, including knowledge of the "substitutes" for the environmental commodity in question (William Schultz, in NOAA 1992, 118.).

These arguments presented something of a paradox for CV proponents. On the one hand, respondents' relative ignorance with regard to, e.g., the dollar value of a plover justified in-depth and iterative survey techniques, in which respondents' motivations could be assessed and their answers reinterpreted in order to better conform to the theory behind the survey. On the other hand, this process of education itself was accused of producing the very preferences it purported to measure. As one API economist argued, this kind of "ex-post elicitation plus education" necessarily introduces bias (Zvi Griliches, in NOAA 1992, 165).

The discussions around these criticisms, reproduced in the meeting's transcript, raised a number of questions that, in the words of one industry-supported economist, went "to the heart of welfare economics and the philosophy that underpins the use of economics in government policy" (Plott 1993, 467). Panel members pointed out that the same criticisms could be extended to all kinds of market research, as well as to the use of referenda for social decision-making. For instance, in an exchange with Panel co-chair Robert Solow, Berkeley psychologist Michael Kahneman (drawing on industry-sponsored research) argued that, while the values revealed in CV studies may be both "real" and "significant," they do not "obey the logic of economic value," and therefore should not be included in damage assessments.[84] Solow replied: "But then I suppose you would argue that exactly the same considerations apply to referenda or other ways of eliciting willingness to pay for automobiles, telephones, apartments and so on," which, he

[84] The quotes in this and the following paragraph appear in NOAA 1992, 88-113.

pointed out, are frequently used in market research. “So that your argument would be that probably prices do not measure what standard economic theory suggests they measure; and in any case, the whole apparatus of compensation variation, equivalent variation, etc., is utterly meaningless.” Kahneman backed away from this extension of his argument at first, but when pressed, responded: “I think there is a real problem in putting dollar values on anything, including automobiles or whatever. There certainly is a major logical problem in putting dollar values on non-use values… The issue is a fundamental issue as to what we mean by value.”

As Kahneman and others struggled to demonstrate that economic preferences expressed in prices exhibit a “coherence” not evident in CV, Solow exclaimed: “For ordinary market goods, I ask myself what my process of choosing is like, and it is very much like constructing preferences… I don’t look it up in a table in my mind… why should I care whether preferences are constructed?” Similarly, panel member Paul Portney reflected that his process of purchasing a tie is “to an embarrassing extent” a matter of arbitrary whim and circumstance. “Why,” he asked, “is the process through which that private good purchase is made so different than the kind of reasoning that people go through in answering contingent valuation questions, and why should we take the latter much less seriously than the former?”

Charles Plott, an economist at Cal Tech also sponsored by Exxon to testify before the panel, summed up the implications of the industry’s research. CV cannot be a viable method, he argued, because it undoes its own theoretical foundations. The fact that CV values do not behave in the way that rational preferences are expected to behave “calls

into question this fundamental feature [the theory of preferences] of welfare economics" (Plott 1993, 473). If attitudes are constructed based on particularities of context, he argued, "there is no preference; there is no consumers' surplus; and there is no fundamental value in the form of a preference that can be measured and summed in accordance with the economists' notion of efficiency… There are no criteria or means for identifying which of the several 'preferences' is the 'real' preference… If preferences do not exist, then classical welfare economics makes no sense. If classical welfare economics makes no sense, then CV makes no sense" (Plott 1993, 474).

The material issue at stake in these debates was a vast and potentially incalculable new source of business risk. Testifying before the panel, economist Steven Shavell raised the problem of defining the appropriate market size for CV assessments. If the party seeking compensation in a suit were the federal government, then companies could potentially be held to account for the sum total of existence values lost to all citizens. Shavell thus speculated that, given the cultural influence of "Flipper" and "dolphins at Marineland and so forth," if the population of the US were to agree on average that the life of a dolphin is worth a dime:

> even a relatively minor adverse event like the death of 100 dolphins could, in my mind, easily result in a $2 billion liability to a corporation. What that means to me is that, were CV to be used in the courtroom, a completely new element of risk would be injected to the business environment, a very large risk, and the consequences would be the usual ones, namely that businesses would withdraw from socially desirable lines of activity (in NOAA 1992, 223).

The panel's discussion repeatedly returned to this argument. Panel co-chair Kenneth Arrow's attempt to tease out the problem is instructive:

> If you take something like dolphins and you come up with a figure which per person is nontrivial, it's not the multiplication by the number of people. It's multiplication by the number of conceivable environmental insults that bothers us, that somehow if you multiply those together – and they're real. I mean, they're there… You know, you have whooping cranes, but you also have other animals… pandas in China or something like that. Pandas are very cuddly, valuable animals, and so forth... It's the ratio of the total number – the value of an individual environmental insult multiplied by the number of insults in proportion to the….

He trails off, concluding: "Well, there's an environmental budget per individual. This has nothing to do with multiplying the number of people" (in NOAA 1992, 278).

In these conversations, expanding the purview of economic rationality to encompass environmental concerns threatens to render neoclassical notions of value both incoherent and impractical: how is the state to identify the "environmental budget per individual" that will enable the market to operate? For industry, the incalculability of these values was of equal or greater consequence than their magnitude. The *Ohio* decision had confirmed that "a representative population for survey purposes cannot be determined prior to damage to a resource" (*Ohio v. DOI*, 48). This meant that the financial risks involved in oil production and transport were inherently immeasurable prior to a disaster, as there would be no way to estimate in advance how many people might be harmed by a spill. Industry experts therefore advocated in favor of a per-barrel tax on oil in lieu of post facto assessments, and even expressed willingness to use CV methods to assess what this tax might be, so long as it was determined beforehand so that risk could be calculated (Richard Zeckhauser, in NOAA 1992, 185; Bill Desvousges, in NOAA 1992, 252-3).

The CV debates raised the prospect that polluting companies would be held to account, in material terms, for the sum total of popular environmental concern exemplified by the environmental movement. At stake in the problem of environmental valuation was therefore the terms on which environmental values would be recognized in public policy, and the degree to which industry could regain control over this process. The NOAA debates illustrate how the problem of *homo economicus* – as both an analytic tool and a practical principle of government – was taken up not strictly within neoliberal theory, but in response to specific urgencies that forced the problem into political life. The *Valdez* disaster sparked such a moment, at which the problem of the nature and limits of economic rationality became a matter of material consequence for the oil industry and government agencies.

But the industry-driven critique of neoclassical rationality went beyond CV. Concurrent with the panel's work, Exxon was marshaling its legal resources to discredit the claims of more than 52,000 private plaintiffs for damages from the spill (Jenkins and Kastner 1999, 155). By settling with state and federal trustees for damages to natural resources in 1991, Exxon had curtailed the ability of private plaintiffs to sue for environmental losses (155). However, the company still faced the claims of fishermen, workers, and others who had suffered direct economic harm from the spill. The highly-publicized trial commenced in May 1994, and when the verdict was returned in September of that year, Exxon was faced with $287 million in compensatory damages and a $5 billion punitive fine. It was the largest punitive award ever leveled against a company (Jenkins and Kastner 1999, 192).

Exxon vowed immediately to fight the punitive verdict to the bitter end.[85] In its appeal, Exxon mobilized its research prowess again, funding a study by the psychologists Cass Sunstein and Daniel Kahneman which demonstrated that jurors were unable to rationally translate shared moral judgments into monetary terms, resulting in "erratic, unpredictable, and arbitrary [punitive] awards" (Sunstein, Kahneman and Schkade 1998, 2074). This problem, they argued, pertained to any legal situation in which people were "asked to map their judgments onto an unbounded dollar scale," including CV (2074). Drawing on the industry-sponsored CV research, they argued that monetary judgments should be taken out of the hands of juries and standardized in order to ensure a degree of predictability. They showed that their conclusions buttressed legal decisions on which Exxon was relying in its appeal (e.g. 2142, note 248), arguing that judges should reject fines that were "out of line with general practice and relevant comparison cases" (2148).

Exxon's ability and incentive to fight its legal battle was enabled by a novel financial arrangement for the punitive award. Contrary to established legal practice, which would have required Exxon to place the $5 billion in escrow to protect the funds through the appeals process, Exxon convinced the court to allow it to secure a credit line for the amount of the award, thereby enabling the company to retain control of the funds. As plaintiffs' attorneys and other critics charged, this allowed Exxon to invest the funds at a higher rate of return than the standard 5.9% interest on damage charges, enabling the company to effectively make money on the process. Commentators estimated that the

[85] The company made good on its promise, and the litigation was not settled until 2008, when the Supreme Court reduced the punitive damages to only $507 million (*Exxon Shipping v. Baker,* 2008).

return on these investments through 1998 alone was more than $3 billion, far exceeding Exxon's estimated $300 million in legal fees (Jenkins and Kastner 1999, 207).

But this financial arrangement was novel not only for the legal system. Since 1988, the financial industry had been trying to figure out how to get around the higher reserve requirements on corporate loans required by the Basel Accords. When Exxon requested a $4.8 billion dollar credit line from JP Morgan, Blythe Masters, the head of the bank's derivatives group, recognized a unique opportunity to engineer a way past the regulatory limits on the bank's credit exposure. Masters executed a deal with the European Bank of Reconstruction and Development (EBRD) in which, for a fee, the EBRD would take on the risk of default while JP Morgan retained ownership of the underlying loan. The arrangement – termed a credit default swap – was the first concrete demonstration of credit derivatives (Tett 2009). When subsequently standardized by Masters and her team, this innovation would enable the proliferation of millions of sub-prime mortgages. Through Exxon's efforts to insulate itself on multiple fronts from financial accountability for the *Valdez*, the spill finds an unexpected afterlife in the economic violence of the Great Recession.

Conclusion: Afterlives of *Valdez*

Big oil is arguably the poster child for green accounting and environmental issues. Recently, however, I believe that the financial sector has wrought as much damage to social welfare as the resource sector has – maybe more, depending on how you measure it… Is there any substantive difference between an oil spill in the Gulf of Mexico that ravages the ecosystem and a financial meltdown due to a spate of derivative counterparty defaults that wipes out the savings of a billion people?

– Daniel Thornton[86]

[86] In Thornton 2013, 10.

Neoliberalism is… the catastrophic political management of catastrophe.

– Subcommandante Marcos of the EZLN[87]

Dempsey and Robertson (2012, 2) have argued that ongoing controversies about environmental valuation attest to internal fissures within neoliberal environmentalism, and may offer points of intervention for more progressive alternatives. Taking their argument one step further, I want to suggest that debates about environmental valuation also describe a central faultline within the broader neoliberal moment in which we live. In keeping with the larger argument of this dissertation, the afterlives of *Valdez* offer an example of how neoliberalism comes into being partially *through* the problems, contradictions, and tensions around environmental valuation.

In concluding, I want to briefly sketch some of these afterlives in order to reflect on how they might trouble our historical understanding of neoliberal environmentalism. The environmental valuation controversy had its most immediate implications for CV research, and for the way that environmental values are recognized in public policy. The panel's final report affirmed CV as a viable method, but established strict guidelines that would increase the cost of CV studies significantly (Arrow et al. 1993). The final OPA rules "relied heavily" on the work of the panel, affirming the validity of CV for damage assessments under the OPA and adopting many of the panel's recommendations (NOAA 1994, 1143). Beyond the rulemaking process, however, the report helped to set the research agenda on CV for the next few decades, and the flurry of research and expert attention prompted by the OPA significantly advanced the methodology (Carson and

[87] In Subcommandante Marcos 2005, 108.

Hanemann 2005, 841). CV is now widely used by government agencies in the US, Canada, and elsewhere for purposes of cost-benefit analysis, and in public policy research ranging from criminal justice to public health and care work (Carson 2012). In environmental economics and policy, CV is now an established method by which new natures are rationalized and made legible to capital and the state.

In the decades since the spill, the industry's orientation to the problem of environmental valuation has changed markedly. Driven by regulatory pressure, environmental opposition, and shareholder activism inaugurated by the Valdez Principles, the oil and chemical industries embarked on a dramatic change of course in the late 1980s toward what Andrew Hoffman (2001) has described as a new era of "strategic environmentalism." While this shift has been neither smooth nor complete, corporate social responsibility (CSR) has been widely recognized as involving a "displacement of core regulatory functions… from the state to the corporate sector," advancing the privatization of environmental governance and helping to reestablish corporate sovereignty over environmental issues (Sadler and Lloyd 2009, 613).[88] CSR should be seen not simply as greenwashing in the sense of a contentless façade, but as a strategic containment[89] of environmental concern toward reestablishing corporate sovereignty in environmental governance.

Examining environmental valuation as a political problem reminds us that new strategies for measuring natural capital values do not necessarily operate in the service of

[88] Exxon, Shell, BP, Dow, and Monsanto, among many others in the petroleum and chemical industries, have entered into high-profile partnerships with major environmental NGOs. See for instance Hance 2016.

[89] See Coleman and Yusoff's interview with Elizabeth Povinelli (Coleman and Yusoff 2014).

capital accumulation. The process of rationalizing these values and bringing them into line with the demands of accumulation is riddled with tensions and inconsistencies that, as Dempsey and Robertson (2012) show, persist in the present. But it also demonstrates how efforts to contend with this problem produce more far-reaching effects. In short, we should not be too narrowly focused on cataloging new types of ecological devastation when asking after the consequences of neoliberalism's environmental turn.

In its attempt to discredit the CV method by insisting upon a narrow interpretation of economic preference, the oil industry inadvertently helped to advance a new generation of behavioral economics that would move well beyond the insights of Becker. Carson and Hanemann (2005, 840, note 30) note that "[t]here is, of course, some irony in that many of the key tenets of what is now often referred to as the behavioral economics revolution were first demonstrated in CV studies and declared anomalies of the method rather than actual economic behavior." The psychological research conducted by Kahneman, Sunstein, and others would become foundational to this new behavioral turn, exemplified by a "libertarian paternalist" approach to governance focused on the construction of "choice architectures" that "nudge" behavior in socially-desirable directions (Thaler and Sunstein 2009). As Jones et al (2011) argue, libertarian paternalism entails a new conception of economic rationality and the role of the state in society, one that does not smoothly map onto neoliberal orthodoxy and yet reinforces many of its key tenets. Behavioral economics amplifies the tendencies that Foucault identified in the early works of neoliberal thinkers, while also indexing the internal tensions within the neoliberal project itself. It transforms the critique of neoclassical rationality into a

formula for a subtle, 'environmental' governmentality, which "operationalizes" subconscious desires and affective responses in order to condition economically rational behavior (Jones et al. 2010, 489; McMahon 2014).

Perhaps the most surprising and consequential result of *Valdez*, however, was an innovation that has qualitatively transformed the role of finance in the global economy and the function of credit in consumer life. The unprecedented size of the punitive award, combined with Exxon's status as a customer to whom JP Morgan could not refuse a loan, provided a unique impetus for this revolution in risk management at a moment when the problem of credit derivatives was a top priority for the bank (Tett 2009). The credit default swap enabled a temporal displacement of the underlying problem of catastrophic risk, buying Exxon the time and capacity to successfully resist its punitive fine and enabling both companies to free up capital that would otherwise be constrained by judicial and regulatory requirements. The credit default swap thereby emerged as a technology for socializing the catastrophic risk (both environmental and economic) endemic to late capitalist life, projecting the impact of environmental disaster into a future financial catastrophe.

As a formative moment, the *Valdez* helps us to understand neoliberal environmentalism not as a direct outgrowth of neoliberal ideology, but as an ad-hoc series of responses to disaster whereby political orientations and social values antithetical to petro-capitalism are redirected toward the renewal of accumulation and the reinstatement of corporate sovereignty. My goal is not to suggest that the innovations in economic theory and practice discussed here would not have occurred otherwise, in a different

manner and at a different moment. Instead, tracing these afterlives highlights the complex causalities of capitalism that link the material qualities of oil and its effects on shoreline ecosystems to the flux of oil and financial markets, renarrating the history of neoliberalism (and neoliberal environmentalism) as a story of managing catastrophe. For instance, the history of the credit default swap in response to Valdez comes full circle with the financialization of climate change governance through new ways of securitizing environmental risk, such as catastrophe bonds and weather derivatives (Cooper 2010; Elsner 2009; Pryke 2007). These products transfer climate risk onto capital markets and enable portfolio diversification through the transfer of financial risk onto climate fluctuations, further integrating financial and ecological processes (Mills 2008; Cooper 2010). In this light, following Ian Baucom (2005), the Valdez exists as a "non-synchronous contemporaneity" to financialized climate change.

In this way the afterlives of Valdez shed a different light on the temporality of counterrevolution, revealing it to be not an accomplished program but an ongoing series of attempts to contain forces of social change in response to disaster. What is carried forward in this process is therefore the “remembrance” not only of past struggles (Virno 1996), but also of the devastations they contested. At the same time this history points toward an affirmative critique of environmental valuation, as a political problem that concerns how, and by whom, nonhuman forms of existence will or will not be valorized in economic life. My wager is that attending to the heterogeneous logics that have historically come to constitute the neoliberal project may highlight fissures through which to intervene in its present. This chapter offers a provisional starting-point for such

an analysis by charting the places where the residues of the *Valdez* persist, beyond the ecologies of the Alaskan coast, in the enduring catastrophe that is neoliberalism.

Conclusion: Beyond neoliberal environmentalism

We're all aware that organisms work on the environment, and that that work is useful. What I'm saying is that I don't think we have even begun to scratch the surface in terms of the biological potential of organisms on the planet to change environments. I mean they've been doing it for billions of years and we've been doing it for only about 200, or 10,000 if you're generous… It's not just about a question of saving biodiversity and conserving ecosystem services, it's actually enhancing the work rate on the planet of the biota. Because if we don't do that, we're going to get ourselves back into exactly the same problems we have.

– Clive Jones[90]

Ecosystems are infrastructure.

– The Nature Conservancy[91]

Together, the above statements articulate the new paradigm of environmental governance that this dissertation has aimed to problematize. In the contemporary moment, nature is encountered not simply as a static collection of resources, but as a set of dynamic capacities that, through the right forms of measurement, valuation, and engineering, might be harnessed toward productive ends. As Clive Jones emphatically stated in his talk on bioremediation at the 2014 Ecosystems Economy and Society Conference at the US National Academy of Sciences, environmental conservation and management is no longer simply a matter of preserving natural resources and amenities for future generations; it is a matter of putting life to work — including all of the planetary "biota." The failure to do so is not only a missed economic opportunity, but a promise of ecological peril; in other words, putting life to work is necessary for securing (some forms of) human life by mitigating the destructive impacts of our more

[90] Jones 2014.
[91] TNC 2016:2

conventional ways of exploiting natural resources. As The Nature Conservancy (TNC) would have it, it is their critical role in securing the conditions of human life that make ecosystems, in a non-metaphorical sense, "infrastructure."

The imperative to mobilize these capacities by working with, rather than against, ecosystem dynamics is simultaneously a governance problems (requiring new institutional forms and management processes), an engineering problem (requiring new techniques and technologies for designing and assessing environmental systems), and a security problem (requiring new ways of managing risk and uncertainty). Perhaps above all, it is a valuation problem. The now massive research and policy on natural capital, ecosystem services, and market conservation is oriented around a unifying claim: that our environmental problems stem from our failure to incorporate the value of nature into our economies, and that a solution to this crisis can only come by finding the right price.

From the critical geographical literature, however, it would seem that this project is doomed to failure, if it has not failed already. The case study literature on ecosystem services and environmental markets has provided detailed accounts of the difficulties involved in rendering new natures subject to measure, abstraction, and commensurability, and in realizing their value through exchange (Bumpus 2011; MacKenzie 2009; Robertson 2006; Lansing 2011; Fletcher 2014). As Jessica Dempsey and Daniel Suarez (2016) have recently shown, efforts to unlock new sources of profit from biodiversity conservation are foundering. Among both critics and proponents of market-based conservation there is increasing recognition that "there is not necessarily much actual commodification taking place through these mechanisms" (Dempsey and Suarez

2016:661), leading some scholars to conclude that "many ostensible neoliberal conservation mechanisms do not function as such in practice" (Fletcher, quoted in Dempsey and Suarez 2016:661). As Dempsey and Suarez write:

> If the proliferation of such schemes cannot be appropriately characterized as the outcome of a class project propelled by the accumulative drive of elites (as commonly theorized in neoliberal conservation scholarship via David Harvey), we are left with difficult but important questions regarding how to interpret their emergence, how to understand their specific consequences, and how we might intervene in their potential trajectories. (Dempsey and Suarez 2016:655)

But the failure of these schemes to deliver on their promises of a reinvigorated green capitalism is only surprising if we buy into a narrative (whether critical or celebratory) that views them as part of a coherent program whose hegemony is secured. This dissertation has argued, in contrast, that what we call neoliberal environmentalism is an ad-hoc convergence of forms of knowledge and technologies of governance that were never made to fit together. We might therefore describe it as an apparatus of government in Foucault's sense, a network established among "a thoroughly heterogeneous set consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral, and philanthropic propositions" in response to an urgency (quoted in Braun 2014:51). The degree to which these disparate elements, with their own diverse genealogies, work to reproduce capitalist class power and the conditions of accumulation is always contingent, such that their operation within a broader apparatus of neoliberal environmentalism must be continually re-secured. Moreover, as Braun and Wakefield emphasize, an apparatus is always generative — of new desires, subjectivities, and urgencies that call forth new responses, in a "perpetual process of strategic elaboration" (Foucault, quoted in Braun and

Wakefield forthcoming:21). In other words, the elements that make up the apparatus of neoliberal environmentalism (valuation methods, scientific practices, regulatory changes, environmental management techniques) have multiple political lives and tendencies, which shape the trajectory of the apparatus as a whole.

The genealogical account developed in this dissertation indicates that the political terrain unfolding under the banner of neoliberal environmentalism may be more complex and more varied than it appears in critiques of neoliberal natures. This requires new critical approaches, as the tendency of the critical literature to focus on deviations from a pre-conceived model of commodification and marketization can distract from the important work that these programs *are* doing.[92] By the same token, contrasting private to public finance leads to the conflation of markets with neoliberalism, and a tendency to undertheorize of the role of state and public institutions (cf. Parenti 2015). Shifting our focus to neoliberal environmentalism as an apparatus of government highlights its heterogeneity and indeterminacy. At the same time it enables us to see how the production of the environment as an object of politics has been formative of neoliberalism as we know it. In the preceding chapters, I have shown how many of the distinctive features that we associate with neoliberal natures are not simply preexisting neoliberal strategies applied to environmental problems, but rather emerged through the process of defining the environment as an object of governance and political concern, in response to what I have called the 'environmental crisis' of Fordist-Keynesianism. This reverses the conventional understanding of the relation between neoliberalism and

[92] To be fair, Dempsey and Suarez (2016:655) are careful not to "suggest that neoliberal conservation is inert or benign because it is small," drawing attention the antipolitical effects of discourses of market-based environmentalism.

market-based conservation in geographical literature, suggesting that controversies around environmental valuation are not simply the result of the neoliberal turn but formative of it. In this way, the project challenges accounts of neoliberalism that marginalize or ignore environmental governance, showing the formative role of environmental politics in economic crisis and change. In the process it demonstrates that the heterogeneity of neoliberalism is not only a product of the diverse socio-natural contexts in which it unfolds, but is present at its origin, in the plurality of forces and strategic agendas that suffuse its future histories.

In this conclusion, I explore how a genealogical approach might help us to reevaluate ecosystem services and natural capital and to perceive new political possibilities not visible through the lens of neoliberal environmentalism. Recalling the discussion in the dissertation's introduction, reevaluating ecosystem services and natural capital means not simply renarrating their conditions of emergence, but doing so in order to discern the relations of force working through them in such a way as to enable new valuations. This end I first work through some of the tendencies within the neoliberal natures literature that obscure our vision, namely the approach to value taken in this literature and the preoccupation with commodification and markets as the dominant terms of critique. I then develop the concept of infrastructural nature proposed in Chapter 1 through a review of recent developments in 'green infrastructure' and Payments for Ecosystem Services (PES) programs. Attending the diverse ways that nature is being produced in an infrastructural mode, I argue, might lead us away from the constraints of 'neoliberal environmentalism' to an understanding of the diverse forces and political

rationalities at work in these programs, and to a more nuanced and generative critique of their bio- and geo-political implications.

The problem of value has emerged as a central theoretical problem within the geographical literature on neoliberal natures (Robertson 2012; Robertson and Wainwright 2013; Kenney-Lazar and Kay 2017; Christophers 2016; Huber 2016; Kay and Kenney-Lazar, in press). Building on the work of eco-Marxist critics in the 1960s, geographers have sought to reintegrate nonhuman nature into the labor theory of value, generally pointing to Marx's *Critique of the Gotha Program* to argue for a greater emphasis on nature as the source of use values that are transformed by labor through the production process (Huber 2017; Parenti 2016; Robertson and Wainright 2013). For instance, in his contribution to a recent special issue of *Capitalism Nature Socialism* on "The Value of Capitalist Natures," Matthew Huber (2017) proposes five theses toward a "value theory of nature" inspired by Diane Elson's (1979) value theory of labor. Against critics who would argue that Marx ignores nature's value, Huber argues that Marxian value theory shows how capitalism systematically devalues the natural conditions of production (Huber 2017:44). In contrast to neoclassical subjective theories of value that would promise to internalize the value of nature into the economy, Huber argues, Marx's value theory shows us the impossibility of this by locating value as an antagonistic relation internal to capitalist production.

Huber's intervention deserves attention because it exemplifies some of the defining features and limitations of discussions of value in contemporary environmental political economy. While Huber claims inspiration from Elson's analysis, his argument

shares little with her approach. In the 1970s, Elson argued that Marxian political economy was preoccupied with a misguided focus on the technical problems related to the how value is transformed into price. This myopia, she argued, distracted from the real political import of Marx's critique:

> My argument is that the *object* of Marx's theory of value was labour. It is not a matter of seeking an explanation of why prices are what they are and finding it in labour. But rather of seeking an understanding of why labour takes the form it does, and what the political consequences are (Elson 1979:123).

Thus she proposed the "value theory of labor" as a critical reversal that highlighted value as a disciplining structure that determines what 'counts' as value-producing activity, and the specific forms and conditions under which it is performed. In this way Elson repositioned Marxian value theory as a political rather than a technical problem, drawing attention to the historical and political processes through which value-producing activity is determined and disciplined.

In contrast, Huber — in an argument that reflects the terms of debate on value in the broader neoliberal natures literature — seems to participate in the approach Elson rejects, seeking out human labor to prove or disprove the presence of value: "Under capitalism, no matter how much we may subjectively believe something has value, if it takes no labor to produce it, it will yield no value in the technical/economic sense" (Huber 2017:44). In this way, the labor theory of value is invoked mainly to give the lie to subjective theories of value dominant in mainstream economics. The crucial difference between the two, Huber proposes, is that the former shifts our perspective away from altering preferences to focus on producing the world differently. However, by taking labor for granted as an unproblematized category that we might (fail to) discover within

so-called environmental commodities (such as ecosystem services), Huber in fact turns away from the processes by which discourses of ecosystem services and natural capital *are* producing the world differently; indeed, that is their whole purpose. Ultimately, the question of whether we can locate some kind of 'real' value within environmental markets by 'finding the labor' is a concern of relevance only to (a narrow branch of) Marxist theory.

Further, in a move that is again emblematic of the broader geographical literature, Huber qualifies the point that capitalism necessarily devalues nature by turning attention to those "parts of nature" that it does value: e.g. coal, oil, timber, etc. (Huber 2017:47). Huber writes that "[o]nly paying attention to the nature capital does not value led [James] O'Connor to theorize nature as a set of external ecological 'conditions' somehow 'outside' the relations/forces of production" (48). But this raises a crucial point that is at the heart of the current project: while we should certainly pay attention to the "internal materiality of nature's role in the production and reproduction of social life" (48), arguments about value become nonsensical when we start talking about how capital relates to 'nature' in a general sense. 'Nature' is not something that wetland offsets, board feet of lumber, beef cattle, and barrels of oil have in common. In this sense, this dissertation has stressed the importance of understanding the environment as a *relative* term, in this case defined in relation to capital as a process of value in motion. What unites the forms of nature given value as ecosystem services and natural capital is that they are *environmental*: they were previously devalued by capital, forming part of its constitutive outside or, in the terms of O'Connor on whom I'll draw below, the conditions

of production.[93] These environmental forces are not simply 'drawn in' to circuits of commodity production, but are subject to new styles of value extraction and management. In this sense ecosystem services and natural capital – describing the socio-ecological 'work' of purifying water, sequestering carbon, or mitigating floods, among other things – find common ground with forms of gendered reproductive labor also devalued by capital, more so than with conventional resources such as coal or timber. This is not to claim that the "ecologies internal to the social relations and cultural politics of capitalism" (Huber 2017:48) are irrelevant, but we cannot simply look to them to draw general conclusions about how capital relates to "nature." To do so reifies the very distinction between nature and society that environmental political economy perpetually aims to destabilize.

The genealogical account offered in this dissertation implies a different entry point to the problem of value in neoliberal environmentalism. Taking Elson's critique seriously, we might ask how the crisis of value (as measured in socially-necessary labor time), diagnosed by Negri (1996), gives rise to new forms of labor that mobilize complex articulations of human and nonhuman capacities, bringing 'reproductive' activities directly into the sphere of economic calculus. In other words, when we stop looking for labor as we know it, new modalities of labor may become visible, along with new solidarities. This turns attention to value as an antagonistic process concerning how the activities involved in the production of life will be valorized (and for whom), and through which non-capitalist ways of valuing must continually be coopted and/or invalidated.

[93] Indeed, O'Connor (1988) is quite clear that the conditions of production do not align cleanly with nonhuman nature, but encompass social conditions as well as the reproduction of labor-power.

This process entails not only new commodity forms, but also new types of biopolitical investments in the administration of life.

To illustrate what I mean by this, consider the now widespread phenomenon of Payments for Ecosystem Services (PES) programs, which provide payments, incentives, or compensation to landholders in exchange for conservation activities that preserve or enhance ecosystem services. In the classic market-based definition of PES, Sven Wunder (2007) argues that such payments must be direct exchanges between service 'buyers' and 'sellers,' conditional upon the delivery of a clearly-defined 'service.' Critical scholars have taken up this definition to portray PES as a primary feature of 'neoliberal natures,' enacting "economistic simplifications of socio-ecological complexities [that] capitalise landscapes such that they can be brought into variously financialised exchanges in new ways" (Sullivan 2013:206; see also Robertson 2006, Dempsey and Robertson 2012, Fletcher et al. 2014). As dozens (if not hundreds) of similar programs have been established around the world, however, scholars and practitioners of PES have pointed out that they rarely conform to the ideal market model. For one thing, the materialities of the ecosystem services in question – which may range from forest carbon to drinking water, or from air quality to endangered species habitat – evoke different forms of measure and calculation. For another, while the market model remains the ideal among major funders of PES programs and multilateral lending institutions, market-based PES models are routinely modified and transformed in confrontation with particularities of context, national agendas, and pushback from local actors (Shapiro-Garza 2013). The language of PES is rarely used in the internal discourse of such programs or with local

actors and participants.[94] For critical scholars, the diversity of PES has presented a series of conundrums as to what really defines PES in practice, and what unites these programs other than a shared rhetoric at the level of international funding institutions and NGOs.[95] In particular, scholars have highlighted the strong role of the state in many PES programs, which are often more akin to subsidies than true market payments, as evidence that the neoliberal market ideal remains just that (Shapiro-Garza 2013; Dempsey and Suarez 2016). In other words, the evident failure of the market model may reveal the heterogeneity of 'neoliberal environmentalism' in practice, but it has so far led to few conclusions about the new political terrain opened up through the widespread revaluation of nature advanced under the heading of PES.

To sketch this terrain, we might recall the two modalities of ecosystem services highlighted in Chapter 1. A first meaning of ecosystem services introduced the idea that any subjective benefit provided by nature can be considered a 'service.' This meaning persists in contemporary PES and ecosystem services research, functioning as a hegemonic discourse that (as critical scholars have pointed out) aims to 'translate' all ways of valuing into economic terms, thereby warping or excluding ways of valuing that do not conform with these logics. But there has been less engagement with the second meaning of ecosystem services identified in Chapter 1, which entailed a new economic analysis of ecosystem function – of the productive capacities of ecosystems to perform essential life-support functions. This idea, I suggest, underpins but extends beyond the

[94] This statement is informed by conversations and interviews with scholars and practitioners involved in many PES programs over the past 3 years.

[95] This was a topic of some discussion at a recent conference on Alternative Discourses of PES (ADPES) that I attended at Duke University (April 10-12 2017), which brought together scholars and practitioners from five different national PES programs.

discourse of ecosystem services, such that the production of nature in an *infrastructural* mode can be considered a key feature of neoliberalism. In this light, we can view the contestations over valuation and compensation in PES as not simply modifications to or rejections of a neoliberal model, but as conflicts over whether and how life can be 'put to work,' and for what. This enables us to ask new questions about the politics of PES: insofar as infrastructure involves investment in the promise of future development (Hetherington 2014), what kinds of future imaginaries and political rationalities operate through these programs? How might the rescaling of environmental governance in line with ecological boundaries enable new antagonisms and new solidarities? What is the work involved in managing and maintaining this infrastructure? What articulations of public and private finance are working through them?

Shifting our focus to the various ways in which an infrastructural nature is produced and managed in the contemporary moment expands the possibilities for critical engagement with so-called neoliberal environmentalism beyond the critique of commodification and markets. For one thing, it invites a more nuanced engagement with the role of the state in contemporary transformations of nature. The tendency for critical geographies of neoliberal natures to hold state finance as proof against the presence of markets (and therefore as an indication of the failure to neoliberalize nature) can be seen as evidence of a persistent gap that Christian Parenti (2015) has diagnosed between environmental political economy and Marxist state theory. As Parenti argues, however, it is the capitalist state, as the "territorialization of political power," that necessarily delivers nonhuman natures to capitalist production (831, quoting Bob Jessop). It does this through

three key functions: place-based property regimes, the construction of infrastructure, and the development of scientific practices that make new natures legible and accessible.

In this way, the discourse and practice of ecosystem services and natural capital are technologies of *geopower* as defined by Ó Tuathail (quoted in Parenti 2015:835), refering to "an ensemble of technologies of power concerned with the governmental production and management of territorial space." While state actors play a crucial role in this process, however, in the context of this project it is important to emphasize that the state does not constitute a center from which geopower emanates in any determinant way. The degree to which ecosystem services and natural capital, as geopolitical technologies, operate in accordance with neoliberal principles – e.g. engender environmental de- and re-regulation that create the conditions for markets, or the establishment of 'market proxies' in public institutions and state agencies (Castree 2008a; Collard, Dempsey and Rowe 2016) – is however not a foregone conclusion. Instead, the political terrain of 'neoliberal natures' is shaped by a diversity of public and private interests, national agendas, social movements, and biophysical conditions.[96]

[96] For instance in their report on the State of Watershed Investment in 2016, Forest Trends – the leading organization for environmental markets assessment – charted $25 billion worth of transactions for water-related "green infrastructure" alone, referring to the restoration, maintenance, or production of "natural and semi-natural" hydrological systems with the aim of enhancing water quantity and/or quality available to populations, water utilities, or private entities. Watershed investments in green infrastructure tend to incorporate or overlap with PES, insofar as they often involve payments or compensation for conservation. The overwhelming majority of these investments ($23.7 billion), the report found, came through "direct subsidy payments from supranational, national, and state-provincial-level governments to landholders to protect and restore water-critical landscapes and promote a green economy" (Bennett and Ruef 2016:2). In other words, governments are strongly engaged in producing nature in an infrastructural mode, acting as a "buyer, regulator, and enabler" for ecosystem services markets (Scherr and Bennett 2011). And this should not be surprising; as Parenti (2015:841) writes, "[f]ew forces call forth the state so consistently as does water."

If large-scale infrastructure investment is a key mechanism through which the state "delivers nature's use-values to capitalist production," the production of infrastructural nature intensifies this relation, such that ecological processes and capacities become themselves the object of infrastructural investment. A Joint Industry Report entitled “The Case for Green Infrastructure,” authored by Dow, Shell, TNC, SwissRe, and Unilever as part of the Resilience Action Initiative, explains that green infrastructure saves money by dramatically cutting human labor costs, putting to work instead the “self-sustaining” and “regenerative” capacities of ecosystems, whose value as assets appreciates rather than depreciates over time (TNC 2013:6, 2).[97] For companies such as Dow, which is actively partnering with TNC to integrate the value of ecosystem services into its business planning,[98] ‘green infrastructure’ names a set of accounting and engineering technologies that enroll ecosystem resilience into a form of fixed capital that can respond to conjoined economic, ecological, and socio-political turbulence (Weick 2015; Reddy 2015; Reddy et al. 2015). Recalling Holling’s early visions for adaptive environmental management, the report promises that “working together with natural systems, and hence green infrastructure, enables organizations to better manage disruptive events, such as power interruption, raw material price increases and mechanical failure which often impair traditional gray solutions” (TNC 2013:3). It also finds that green infrastructure helps to mitigate the ambiguous category of "socio-political risk" by building long-term relations with stakeholders and providing side-benefits such as enhanced biodiversity (2).

[97] The report was developed as part of the companies’ work with the Resilience Action Initiative.
[98] Cire Reddy et al. 2015 and fieldwork.

As biopolitical technologies, investments in infrastructural nature are oriented toward the management of "complex life" (Chandler 2014) that exceeds the normalizing structures of liberal government. In this sense infrastructural nature (like all infrastructure) stands at the intersection of biopolitics and geopolitics, managing populations through new territorializations of state and corporate power. As resilience has pervaded the discourse and practice of urban design, investments in ecosystem services and green infrastructure promise to engender resilient urban systems that can remain adaptive in the face of unpredictable and extreme climatic events (Braun 2014; Wakefield and Braun forthcoming). Thus efforts to economize nature's functions simultaneously entail new styles of governing risk, whether with regard to global supply chains or urban populations.[99]

How then might attending to the production of infrastructural nature, as a set of institutional arrangements, scientific and governance processes underpinning many of the developments gathered under the heading of 'neoliberal environmentalism,' change our perspective on the politics of value in environmental governance? From the point of view of capitalist production, infrastructural nature entails new social relations and material processes through which the conditions of production are reproduced. As James O'Connor described in his seminal 1988 essay outlining the 'second contradiction' of capitalism, these conditions are simultaneously social and biophysical, encompassing the "external physical conditions" of the landscape (including the built environment and infrastructure), social networks and "means of communication," and even labor power

[99] Braun (2014:59) also makes this point, noting that "the emergence of nonhuman nature as that which provides 'functions' and 'services' must also be understood in relation to new conceptions and modes of government of *risk."*

itself (O'Connor 1988:16, quoting Marx). In the terms introduced earlier in this dissertation, production conditions are the constitutive outside of capital, not external to it but not (necessarily) produced by it, encompassing the activities of social and ecological reproduction. Insofar as the conditions of production include the reproduction of labor-power as well as the reproduction of nonhuman natures, they traverse the boundary between geopolitics and biopolitics. Indeed, if the boundary between the two was ever discernible, they overlap more fully in the contemporary conjuncture, when biopolitical interventions are increasingly accomplished through environmental interventions – both in the sense of intervening in the 'milieu' conditioning individual behavior, and in the literal sense by which environmental systems are produced and managed in an infrastructural mode (Braun 2014).

I propose that the constellation of practices and programs engaged in the revaluation of nature-as-infrastructure be understood not simply as the effect of a rapacious global neoliberalism, but as a widespread transformation of the processes and social relations through which the conditions of production are reproduced, which necessarily entails new forms of bio- and geopolitics, and (as argued earlier) a reworking of the division between productive and reproductive labor. Part of the success of ecosystem services and natural capital as discourses has been to obscure the complexity of institutional arrangements and labor processes involved in the production of infrastructural nature. For instance Forest Trends routinely includes a variety of state subsidy programs that do not themselves use the language of ecosystem services or PES in its assessments of ecosystem services markets (e.g. Ecosystem Marketplace 2013).

Many of the flagship 'PES' programs exist in national contexts that explicitly prohibit PES or that have centrally-planned economies; for instance Ecuador's water fund in Quito and its SocioBosque program for forest subsidies; China's 'eco-compensation' programs; Vietnam's national PES program; and Bolivia's watershed conservation programs, which prohibit direct payments in favor of in-kind compensation for conservation. This is not to say that these programs do not incorporate market features or participate in ongoing processes of neoliberalization; but their political geographies cannot simply be understood through a critique of markets and commodification. Instead, as geopolitical technologies (in Ó Thuathail's sense), they make territories legible and accessible to government in new ways, while revaluing land and the labor of those who work it.[100] In Latin America, PES and related programs build on geographies of colonial displacement that pushed indigenous peoples to marginal lands of low agricultural value, revaluing territories and resources in line with national development agendas, social movements, and international environmental markets. In Andean regions, high-altitude páramo landscapes are accorded new value through watershed investment programs that recognize their criticality to water supplies for downstream populations and industries (CITE LAWFP reports), while Mexico's revamped PES program has been criticized as primarily a way to capture international development funds through REDD+, with few changes to forest management (Be 2017).

These processes of revaluing territories and rescaling governance in line with ecological boundaries appears to be creating new solidarities and antagonisms. Shapiro-

[100] For instance, at the recent ADPES conference, practitioners from forest and watershed conservation programs in Mexico, Ecuador, and Guatemala discussed how PES and related compensation schemes brought the state into territories where it had formerly been largely absent.

Garza (2013) describes how Mexico's market-based PES program was transformed into a rural subsidy by a convergence of social movements that reclaimed the program as a "revaluation of the rural." In Vietnam, landholders excluded from the country's forest PES program have destroyed forest out of spite (Giefer and Mechak 2017), while there are anecdotal accounts of Andean residents burning páramo in watershed investment programs in order to negatively impact water supplies for industrial water users downstream (Bremer 2017).

Attending to neoliberal environmentalism as a transformation of social-ecological reproduction also invites further research into how particular labors are valued and devalued in the production of ecosystem services and natural capital, what processes of racialization, gendering, and subject-formation are involved in transforming communities into stewards of ecosystem services, and how this economy may open up new political terrain and new alliances among humans and non-humans. For instance, PES programs often tout the socioeconomic "co-benefits" associated with the programs, chiefly in the creation of new jobs and new sources of income. But these programs play on existing racial, ethnic, and gender hierarchies; in South Africa's national PES program Working for Water, wages are deliberately kept low in order to provide employment for more black women, the demographic most affected by unemployment.[101] In the Water Fund for Life and Sustainability in Cauca Valley, Colombia, indigenous women perform conservation labor for well below the minimum wage (Arias 2015; Dagua 2015). In other words under PES programs socio-ecologies are not simply "abstracted, distanced, *flattened* and

[101] This was a topic of lengthy discussion between government employees in charge of the Working for Water program and other participants at the ADPES conference.

somehow dematerialized" through new commodity forms (Sullivan 2013:121-22), but – as in all labor processes under capitalism – exploitation consists in the (re)production and intensification of difference and hierarchy.

In 1980, Silvia Federici argued that the non-growth movement of the 1970s offered no solution for women, but only an intensification of reproductive labor in the form of "do-it-yourself" forms of life. "Are we not hearing again", Federici (1980/2012:53) asked, "the same glorification of housework, which has traditionally served to justify its unpaid status by contrasting this 'meaningful, useful, and more importantly unselfish activity', with the presumably greedy aspirations of those who demand to be paid for their work?" This dissertation suggests that a response to neoliberal environmentalism will have to navigate a similar problematic: as communities around the globe are enrolled as stewards of ecosystem services through payment schemes, how might we refuse the neoliberal valorization of the labor of ecological stewardship without perpetuating this labor's invisibility? Indeed there is now a whole literature on the problem of value "crowding" in PES programs, which articulates anxieties over how ethics of care and socio-cultural networks that facilitate environmental stewardship may be undermined by monetary compensation (Ezzine-de-Blas, Corbera, and Lapeyre 2015; Rode, Baggethun and Krause 2015). While these are real concerns (and have prompted some indigenous communities to reject PES [vonHedemann and Osbourne 2016]), refusing valuation does not constitute a sufficient response; there are equally those who are actively taking up the institutional structures and discursive tools of PES to forge new valuations of rural lands and livelihoods. A

mode of critique that proceeds by seeking out the features of neoliberalism it knows in advance may remain blind to these new configurations and the political possibilities they present.

In conclusion, I want to return to O'Connor's (1988) classic essay, in order to read it in a new light cast by the current project. O'Connor (1988:17) argued that transformations in the reproduction of production conditions occur through moments of crisis and struggle, in which "[t]he agency of social transformation is 'new social movements' …including struggles within production over workplace health and safety, toxic waste production and disposal, and so on." The outcomes of these struggles, for O'Connor (1988:18), tend toward more socialized forms of the reproduction of production conditions: "economic crisis is the cauldron in which capital restructures the conditions of production also in ways which make them more transparently social in form and content," entailing new cooperative forms of planning, environmental management, health policy, and so forth – a process that for O'Connor establishes the necessary (though not sufficient) conditions for socialism.[102] O'Connor (1988:18) thus proposed the

[102] As O'Connor points out, because the conditions of production demand regulation and investment by the state, they tend to be immediately politicized: "Neither human laborpower nor external nature nor infrastructures including their space/time dimensions are produced capitalistically, although capital treats these conditions of production *as if* they are commodities or commodity capital. Precisely because they are not produced and reproduced capitalistically, yet are bought and sold and utilized as if they were commodities, the conditions of supply (quantity and quality, place and time) must be regulated by the state or capitals acting as if they are the state. Although the capitalization of nature implies the increased penetration of capital into the conditions of production (e.g., trees produced on plantations, genetically altered species, private postal services, voucher education, etc.), the state places itself between capital and nature, or mediates capital and nature, with the immediate result that the conditions of capitalist production are politicized" (O'Connor 1988:23).

"second contradiction" between capitalist relations/forces of production and the conditions of production as a possible second path to socialism.

This dissertation has charted just such a transformation, through which new techniques of environmental knowledge production and governance have arisen through the process of contending with environmental crisis. Insofar as these work to reproduce capitalist class power and the conditions of accumulation, they function as part of an apparatus of environmental governance described as 'neoliberal environmentalism.' But they simultaneously have other political lives and tendencies. And in keeping with O'Connor, they are in many ways increasingly social in form and content, notwithstanding new waves of privatization and enclosure. Corporate investments in environmental valuation and social responsibility entail new forms of cooperation with other businesses and environmental NGOs, which are now a key topic in business literature (Nidumolu et al. 2014). PES programs require cooperation among buyers of ecosystem services as well as among 'suppliers,' while rescaling resource governance in line with ecological boundaries makes visible new connections and shared interests among stakeholders on both sides of the exchange. Adaptive environmental management for resilience involves collaborative engagements among scientists, decisionmakers, urban and regional planners, and citizens. Overall, investments in infrastructural natures require collaboration among state agencies, public utilities, private companies, environmental NGOs, and scientists in order to generate finance and enable management on an ecosystem scale.

Linking O'Connor's insights with Virno's understanding of counterrevolution highlights the way that these new social forms of environmental management appropriate and invert new forms of cooperation developed in resistance to capital, including especially the demands of environmental and other social movements that forms of life outside of market relations be valued on their own terms. For this reason Virno (2004:111) describes post-Fordism as the "communism of capital."

> If we can say that Fordism incorporated, and rewrote in its own way, some aspects of the socialist experience, then post-Fordism has fundamentally dismissed both Keynesianism *and* socialism. Post-Fordism… puts forth, *in its own way*, typical demands of communism (abolition of work, dissolution of the State, etc.). Post-Fordism is the communism of capital (original emphasis).

This does not suggest that these demands have been met in any real sense; as argued above (and as is now well rehearsed in the literature on neoliberalism), the state has not 'dissolved' beyond the erosion of its social welfare functions, but has become arguably more authoritarian, while the exploitation of labor is intensified in increasingly precarious forms. Virno's point however is that the new quality of capitalism can be understood only as a response to the new quality of struggle that emerged in the "failed revolution" of the 1960s and 1970s, which "expressed non-socialist demands, indeed anti-socialist demands: radical criticism of labor; an accentuated taste for differences, or, if you prefer, a refining of the 'principle of individuation'; no longer the desire to take possession of the State, but the aptitude (at times violent, certainly) for defending oneself from the State, for dissolving the bondage to the State as such" (Virno 2004:111).

In light of the intervention in Virno's analysis proposed by this dissertation, we might describe neoliberal environmentalism as the 'eco-communism of capital,' an ironic

realization of O'Connor's second path to socialism.[103] The relations and processes of reproduction may be both more 'socialized' and more autonomous from the organizing function of capital and the state, even as they are subject to new apparatuses of extraction and control. This illuminates a political terrain far different than that commonly depicted in descriptions of neoliberal natures, but one that comes with no guarantees. It must be immediately emphasized, following O'Connor (with whom Virno would likely agree), that recognizing these conditions of possibility guarantees nothing about their actualization:

> Again, nothing can be said *a priori* about "socialist imminence" excepting at a high level of abstraction. The key point is that capitalism tends to self-destruct or subvert itself when it switches to more social forms of the provision of production conditions via politics and ideology. The premise of this argument (like the argument of the present interpretation of traditional Marxism) is that any given set of production condition technologies, work relations, etc. is consistent with more than one set of social relations of reproduction of these conditions and that any given set of these social relations is consistent with more than one set of production condition technologies, work relations, etc. The "fit" between social relations and forces of reproduction of production conditions is thus assumed to be quite loose and flexible. In the *crisis* (in which the future is unknowable), there is a kind of two-sided struggle to fit new production conditions defined as forces into new production conditions defined as relations, and vice versa, into more social forms without, however, any "natural" tendency for capitalism to transform itself into socialism (O'Connor 1988:30, original emphasis).

The payoff of this approach, then, is to become attuned to the contingency and ambivalence of neoliberal environmentalism in ways that may reveal new avenues for its

[103] O'Connor seems to recognize the non-socialist character of the new social movements of the 1960s and 1970s, but only as a limitation to their effectiveness at advancing what is in his mind very much a socialist project. He notes dismissively that " 'difference' has become post-Marxism's mantra," and denounces its emphasis on "site-specificity" and the importance of context. In spite of the rejection of universals, he argues that "there is a universal demand implicit or latent in new social struggles, namely, the demand to democratize the state (which regulates the provision of production conditions), as well as the family, local community, etc." (35). In other words, for O'Connor democratizing the conditions of production necessitates a (socialist) state apparatus.

subversion, while recognizing that this contingency cuts both ways. By taking a genealogical approach, this dissertation has shown (to paraphrase O'Connor) that the "fit" between new techniques of environmental valuation and management and neoliberal imperatives is quite loose and flexible. Augmenting Virno's narrative, this suggests that counterrevolution is not an accomplished program, but an ongoing and ad-hoc series of responses to urgency and disaster, the outcomes of which are the result of micro- and macro-political struggles with no organizing logic or guiding tendency.

In this sense the terrain of environmental politics we now inhabit may in fact be more vibrant than in the 1960s and 70s.[104] In place of the conservative closed-loop ideologies of first-generation systems ecology, the open and bifurcating dynamics of 'Nature Resilient' give rise to new political imaginaries of social-ecological transformation and 'experimental' environmental politics (Nelson 2014; Johnson et al. 2014; Lorimer and Driessen 2013). By revealing the dependencies of major water consumers such as municipalities and multinational beverage corporations on the land use practices of local populations, PES and related green infrastructure programs make possible new solidarities, new demands for resources and state support on the part of marginalized communities, and new recognitions of the value of traditional land management practices and environmental knowledges. Controversies over environmental valuation force adaptations to capitalist business strategy and state agendas, opening doors for the expansion of noncapitalist value regimes and economies.

But again, these new conditions come with no guarantees. Even while we may insist that other possible futures are not yet foreclosed, given the imminent reality of

[104] Thanks to Bruce Braun for this point.

global environmental crisis it is no longer possible to retain the Promethianism implicit in Marx's and Nietzsche's understandings of history. Considering the ecological dimensions of counterrevolution troubles not only the humanist subject implicit within autonomist politics, but also its political temporalities — requiring that our political experiments look backwards as well as forwards when seeking out the tools available to them (Stengers 2017). In this way the genealogy of neoliberal environmentalism reveals new possibilities for politics alongside new devastations. It shows that the afterlives of disaster permeate the contemporary moment; if we inherit the seeds of a future struggle planted by the "failed revolution" (Virno 2004), we also inherit the catastrophes that prompted its militancy and marked its decline. Any attempt to locate the possibilities for other possible futures immanent to neoliberal environmentalism must first recognize that we are living in ruins (Stengers 2017).

Perhaps for this reason more than any other, we may find unexpected tools at our disposal, loosened from their previous affiliations and available for reinterpretation. Discerning these tools requires a critical stance that is open to surprise, that "delights in disturbing discoveries" (Foucault 1984:95), rather than one that seeks out a villain it has met before. It may therefore be necessary to abandon the framework of 'neoliberal environmentalism' altogether, insofar as this takes as a premise what should be a conclusion, continually revealing neoliberalism as a kind of man behind the curtain whose illusions of mastery might be dispelled. We might instead ask what kind of critical practice would be capable of overcoming not only the injustices of environmental devastation, but also the identity of the critic herself who would seek out the truth as a

moral high ground. In the current moment this high ground seems increasingly less secure, inundated as it is by rising seas and hundred-year storms that trouble our established notions of politics, justice, and nature (Chakrabarty 2009). Returning to Foucault's (1984:97) reflections on Nietzsche, "[i]t is no longer a question of judging the past in the name of a truth that only we can possess in the present, but of risking the destruction of the subject who seeks knowledge in the endless deployment of the will to knowledge." Faced with the reality of global climate change and the prospect of human extinction, the sacrificial use of history has perhaps never been more necessary, insofar as it drives us to destroy our established identities, question our critical preconceptions, and to enact new valuations. In this context Nietzsche's polemical demand gains new salience:

> It may be that mankind will eventually perish from this passion for knowledge. If not through passion, then through weakness. We must be prepared to state our choice: do we wish humanity to end in fire and light or to end on the sands? (Quoted in Foucault 1984:96).

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